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1957

1957

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

Established by Convention between Canada, Japan and the United States for the Conservation of the Fisheries Resources of the North Pacific Ocean

ANNUAL REPORT

FOR THE YEAR

1957

VANCOUVER, CANADA
1958

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

MEMBERS - - 1957

CANADA

George R. Clark
John M. Buchanan
James C. Cameron
Roger T. Hager

UNITED STATES

Milton E. Brooding
Edward W. Allen
John H. Clawson
John L. Farley (to Feb. 8, 1957)
Ross L. Leffler (from Sept. 30, 1957)

JAPAN

Iwao Fujita
Koh Chiba
Sakari Masuda (to Jan. 28, 1957)
Kenkichi Nakabe (to Jan. 28, 1957)
Masao Okai (from Jan. 28 to Aug. 31, 1957)
Hideo Okuhara (Oct. 1 to Oct. 11, 1957)
Kenjiro Nishimura (from Oct. 11, 1957)
Kyuhei Suzuki (from Jan. 28, 1957)

SECRETARIAT

Roy I. Jackson, Executive Director
Hiroshi Kasahara, Assistant Director

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

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ANNUAL REPORT

FOR THE YEAR

1957

OFFICES:
University of British Columbia,
Vancouver 8, B. C., Canada

LETTER OF TRANSMITTAL

The Chairman of the International North Pacific Fisheries Commission presents his compliments to the Contracting Parties and their Commissioners and has the honor to transmit herewith an Annual Report describing the activities of the Commission during the year terminating with the end of the Fourth Annual Meeting on November 8th, 1957.

The Report is presented in compliance with Article III (1)(f) of the International Convention for the High Seas Fisheries of the North Pacific Ocean and Rule 14 (f) of the Rules of Procedure.

GEORGE R. CLARK,
Chairman.

FOREWORD

This is the fourth consecutive annual report to be issued by the International North Pacific Fisheries Commission. In addition, since its establishment, the Commission has published a report of the first, or organizational, meeting and two research bulletins.

In accordance with past practice the Annual Report for 1957 is divided into three parts; first, the Chairman's Report of the 1957 Annual Meeting; second, the Executive Director's report on activities of the Secretariat during the past year; third, summaries of the research carried out during 1957 by the various agencies in the three member countries under the Commission's co-ordination and program.

Views expressed in any research report submitted by a national section are not necessarily those of the Commission, unless so stated.

Research in 1957 was focussed on the mid-ocean area where previous studies had demonstrated that intermingling of salmon from the two continents would be most likely to occur. The investigations have disclosed that salmon are more or less continuously distributed across the ocean from Asiatic to North American shores. An extensive zone of intermingling of stocks from the two continents was found in the central North Pacific. However, not all stocks from the two continents have been found in the area of intermingling. Future investigations will be intensified and concentrated on the objective of defining the extent, nature and variability of the intermingling of the continental stocks of salmon.

Investigations of the king crab *(Paralithodes camtschatica)* of the Eastern Bering Sea are being conducted for the Commission by agencies of the United States and Japan, under the provisions of Article III(1)(c)(i) of the Convention. Studies of population size, growth rates and the effects of ocean currents on the distribution of larvae are progressing.

ROY I. JACKSON,
Executive Director.

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I. Report of the 1957 Annual Meeting

of the

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

November 4 - 8, 1957

1. TIME AND PLACE OF MEETING

The Fourth Annual Meeting of the International North Pacific Fisheries Commission was held at the Georgia Hotel in Vancouver, British Columbia, Canada, from November 4th to 8th, 1957. Five plenary sessions, including the opening session to which the public was invited, and one *in camera* session were held.

The plenary sessions were preceded by meetings of various committees and a working session of scientists from the three countries who are concerned with the use of salmon scales for determination of the age of salmon and identification of stocks. The scale scientists met at the Pacific Biological Station of the Fisheries Research Board of Canada at Nanaimo, B. C. from October 23 to 26, 1957. The Standing Committee on Biology and Research met at the University of British Columbia during the week beginning on October 28. The Standing Committee on Finance and Administration met at the University on October 30 and 31 and the Ad Hoc Committee for Study of Reports Submitted Under Article III (1)(a) met at the same place on November 1. All Committees held additional meetings during the week of November 4, at intervals between the plenary sessions.

2. PARTICIPANTS

All twelve members of the Commission, four from each country, were present at the Annual Meeting. The Chairman, George R. Clark of Canada, presided at all sessions. The national delegations also included advisers, experts and, in the case of the United States delegation, members of an Advisory Committee. The total number of participants was 109, consisting of 37 individuals from Canada, 14 representing Japan, 41 representing the United States, 6 officially-invited observers and 11 permanent and temporary members of the Secretariat. The observers represented the International Pacific Halibut Commission, the International Pacific Salmon Fisheries Commission, the International Commission for the Northwest Atlantic Fisheries and the Great Lakes Fishery Commission. Observers from the U.S.S.R. had requested and received permission to attend the meeting but were unable to do so.

A list of the officers and members of the Commission and its committees and the names of all accredited participants in the 1957 Annual Meeting are given in Appendix I of this report.

3. OPENING SESSION

The first plenary session, which was open to the public, was held in the ballroom of the Georgia Hotel in Vancouver on November 4. The Chairman opened the meeting, welcomed the members of the delegations and guests and introduced the Acting Mayor of Vancouver, George T. Cunningham, who delivered an address of welcome.

Commissioner Koh Chiba responded to the address of welcome on behalf of the Japanese delegation. Mr. Chiba spoke of the steady progress made by the Commission in fulfilment of its obligations and expressed the conviction that the continuance of the spirit of international understanding and co-operation would guide the Commission in the years to come. He expressed appreciation for the conservation efforts of the governments and peoples of Canada and the United States and offered assurances that the government and people of Japan were also making their utmost efforts to further rational utilization and conservation of the rich marine resources of the North Pacific.

The spokesman for the United States Section, Mr. Milton E. Brooding, expressed appreciation for the welcome extended by the Acting Mayor of Vancouver and noted that friendship and appreciation of each other's problems are continuing to develop in the Commission.

Mr. Brooding referred to concern expressed by the United States Section at past annual meetings over the apparent loss of salmon of North American origin in the open sea. These apprehensions, he said, have been strengthened by increased catches in certain parts of the Treaty area where accumulating scientific evidence shows the presence of large proportions of salmon of North American origin from which some of the parties to the Convention have agreed to abstain.

On behalf of the United States Section, Mr. Brooding proposed first, that an ad hoc committee be appointed immediately to study the problem of confirming or readjusting the provisional salmon dividing lines specified in the Annex in accordance with the terms of the Protocol to the Convention. The United States Section believed, however, that the proposed ad hoc committee might not be able to complete its assignment in time for action by the Commission prior to the 1958 fishing season. Therefore the United States Section also proposed, pending an appropriate change in the provisional lines, that the adverse effect of fishing in the area of intermingling be minimized by cessation of fishing in areas where, or at times when, a substantial proportion of salmon of North American origin are found.

These proposals, made at the opening session, were discussed by the Commission at later sessions. The results are described later in this report.

Mr. James C. Cameron, speaking on behalf of the Canadian Section, referred to the great progress made by the Commission in a relatively short period of time and gave credit to diligent research, brought about through co-operation and understanding within the Commission. Commissioner Cameron referred, in general terms, to research findings which should be given immediate attention, but felt that a great deal of work remained before the Commission reached its final goals.

The Chairman of the Commission, Mr. George R. Clark, of Canada, reviewed the background, organization, activities and accomplishments of the Commission. He described the principal provisions of the Convention and the extensive program of research undertaken by the Commission, in relation to the question of confirming or readjusting the provisional dividing line for salmon fishing on the high seas.

In summarizing the results of investigations the Chairman stated that a continuous distribution of salmon across the North Pacific has been found. Salmon have been taken in all waters north of 40° N. latitude in winter and 48° N. latitude in summer, and as far northward into the Bering Sea as the research ships have been able to operate. There are strong indications that salmon from Asia and salmon from the portions of Alaska west of Kodiak mingle in the central area of the North Pacific, with the degree of mixing apparently differing somewhat with the species involved. Research techniques have been developed to a point where an effective attack can be made on the most critical problems and areas. Oceanographic investigations are providing a broad general knowledge of environmental characteristics and fluctuations. Every line of investigation is successfully leading to the required knowledge and, in general, to the same conclusions. The Chairman could not say, at this point, that permanent changes in the location of the provisional salmon dividing lines could be recommended, however, he expected further evidence on this important question to be presented by the scientists during the present meeting.

The Chairman also referred to studies being made of the possible conservation needs of the king crab stocks of the eastern Bering Sea. In closing he described preparations in progress for more than two years to enable the Commission to make determinations on whether the salmon, halibut and herring stocks of the eastern North Pacific continue to qualify for abstention of fishing by one or more of the Contracting Parties. The Convention provides that such determinations are to be made annually beginning after the fifth anniversary of the Convention on June 12, 1958. The Commission recognizes the need for rapid, accurate and equitable solutions of the problems assigned to it and is pressing for solutions as quickly as possible.

4. THE AGENDA

The Commission adopted the tentative agenda, which had previously been circulated to the national sections in conformity with the Rules of Procedure, as prepared. In adopting the agenda the Commission first agreed in principle that an item could later be added that would permit consideration of the proposal made by the United States for the establishment of an ad hoc committee to deal with some aspects of the Protocol problem. The United States Section also informed the Commission that it desired to discuss, at the appropriate time, under the agenda item "Other Business", the proposal it had made at the opening session with respect to interim cessation of fishing in the area of intermingling of salmon from Asia and North America. The view was expressed that, under this agenda item, any section could propose for discussion any subject it so desired; however, no decision as to whether or not the subject would be suitable for discussion was taken by the Commission at the time of adoption of the agenda. The agenda as adopted is given in Appendix II of this report.

5. PROCEDURES FOR THE MEETING

After considering a proposal made by the United States Section to the effect that all plenary sessions not held *in camera* be open to the public, the Commission made no change in the policy adopted at the 1956 Annual Meeting, which reads as follows:

> "The first plenary session of annual meetings of the Commission shall be open to the public unless otherwise decided by the Commission. All non-public meetings of the Commission and meetings of its standing committees shall be open to guests and observers who have been invited by the Commission, except meetings which may be held *in camera*."

The Commission, at this annual meeting, continued to follow its previously-established policies for press relations and attendance of members of the press at plenary sessions and meetings of its standing committees. (Existing policy allows members of the press to attend only the public plenary session). The Standing Committee on Finance and Administration was instructed to make recommendations for a policy for press relations at future annual meetings. Its recommendations, as adopted by the Commission, are given in Section 6(d) of this report. News releases and press conferences are the responsibility of a committee consisting of the Chairman of the Commission and one representative designated by each national section, with the assistance of the Secretariat.

Established policy with respect to minutes of plenary sessions was continued. The Secretariat prepares draft summary minutes of each plenary session for review by each national section, following which any needed revisions are made and the minutes submitted for approval at a subsequent plenary session.

6. CONSIDERATION OF ADMINISTRATIVE MATTERS

a. Report of the Chairman

The address given by the Chairman, Mr. George R. Clark of Canada, at the opening plenary session (Doc. No. 127) was adopted by the Commission as the Chairman's report.

b. Report of the Secretary

The Secretary of the Commission, Mr. Edward W. Allen of the United States, presented a report (Doc. No. 122) containing information on changes in Commission membership since the last annual meeting and on submission of certain required reports and information by the Contracting Parties. The report was adopted by the Commission. Members of the Commission and changes made during the year are listed in the inside front cover of this report.

c. Report of the Executive Director

The Commission received the following reports prepared by the Executive Director:

i. *Administrative Report for 1957* (Doc. No. 111)

ii. *Report on the Form and Nature of the Reports Submitted Under Article X (2)of the Convention* (Doc. No. 113)

iii. *Penalties for Violations of the International Convention for the High Seas Fisheries of the North Pacific Ocean* (Doc. No. 105)

These reports, which deal with administrative and procedural matters, were referred to the standing committees for consideration and report to the Commission and subsequently adopted.

d. Report of the Standing Committee on Finance and Administration

The Standing Committee on Finance and Administration reported to the Commission on administrative and fiscal matters as contained in Items 6, 9 and 15 of the agenda for the plenary sessions. The Committee, under the Chairmanship of Mr. Iwao Fujita of Japan and with members as given in Appendix I, met preceding and during the plenary sessions. Its report and recommendations, as adopted by the Commission, are summarized below.

i. The Committee approved the accounts and auditor's report for the fiscal year ending June 30, 1957 and recommended their approval by the Commission. Expenditures by the Secretariat totalled $37,282.93, Canadian funds, for the period. The Committee also recommended that the Executive Director investigate the status and use of working capital funds in other international fisheries organizations and report to the Committee at a later date on the subject.

ii. The Committee recommended that the Commission adopt, for its Secretariat, the pension plan now in effect for employees of other international fisheries commissions whose headquarters are in Canada or the United States. The plan is to be brought into effect on July 1, 1958 or as soon thereafter as is feasible.

iii. The Committee recommended that INPFC Doc. No. 105, entitled "Penalties for Violation of the International Convention for the High Seas Fisheries of the North Pacific Ocean" prepared by the Executive Director, be accepted by the Commission and that a further report be prepared on penalties established and enforced by the Contracting Parties for violations by their nationals of fisheries conservation regulations within areas and for stocks which another Contracting Party or Parties have agreed to abstain from exploiting under the terms of the Convention.

iv. The Committee recommended that INPFC Doc. No. 113 entitled "Report on the Form and Nature of the Reports Submitted Under Article X(2) of the Convention" be adopted by the Commission and transmitted to the Contracting Parties responsible for preparing reports under Article X(2) of the Convention with the request that the Contracting Parties implement the recommendations contained in the report to the maximum extent practicable.

v. The Committee recommended that the Commission accept the report of the Executive Director, INPFC Doc. No. 111, Revision 1, entitled "Administrative Report for 1957".

vi. The Committee recommended that the Commission adopt the following budget for operation of its headquarters during the fiscal year beginning July 1, 1958:

1. Personal Services	$29,600.00
2. Travel	6,500.00
3. Transportation of Things	300.00
4. Communications	1,200.00
5. Rents and Utilities	Nil
6. Other Contractual Services	6,190.00
7. Supplies	1,500.00
8. Equipment	2,400.00
9. Cost of Annual Meeting	1,000.00
TOTAL (Canadian funds)	$48,690.00

Each country contributes one-third of the funds required for operation of the Commission.

vii. The Committee presented to the Commission a budget forecast totalling $47,739.00, Canadian funds, for the fiscal year beginning July 1, 1959. The budget forecast is intended for the guidance of the national sections and is not to be considered for adoption by the Commission until the 1958 Annual Meeting.

viii. The Committee recommended to the Commission a policy for the distribution of the bound volume of records of each annual meeting entitled "Proceedings of the Annual Meeting". Proceedings are to be distributed only to those persons designated from among their nationals by each national section. During annual meetings all accredited participants are entitled to receive copies of those documents arising from the meeting whose distribution has not been specifically restricted by the Commission.

ix. The Committee made the following recommendations in relation to Item 6(b) of the Agenda for the plenary sessions, which had been referred to it by the Commission. This item deals with policy for press relations at future annual meetings. The Committee recommended continuation of established policies which allow members of the press to attend only the initial public opening session of each annual meeting. Press releases at annual meetings are to be the responsibility of a committee consisting of the Chairman of the Commission, one person designated by each national section, and the Secretariat. The Committee also recommended certain steps to allow release of more frequent and timely press information.

x. The Committee recommended that the Executive Director be authorized to prepare and transmit, on behalf of the Commission, recommendations to the Contracting Parties respecting implementation of research programs, budget estimates, requests for reports and information and other similar matters.

xi. The Committee on Finance and Administration, acting in coordination with the Committee on Biology and Research, recommended to the Commission the adoption of a policy for publication of scientific reports, and statistics of fisheries of joint interest. The policy recommendation, which will not be detailed here, establishes procedures for the preparation, editing, approval and financing by the Commission of reports based on information arising from the Commission's investigations.

xii. The Committee recommended that the Secretariat prepare and distribute a quarterly newsletter containing, among other things, information on general activities in the progress of research being conducted by each national section. Each national section is to designate a person to be re-

sponsible for the preparation and forwarding of general reports on research progress. Copies of the newsletter are to be distributed to members of each national section, advisers, experts, etc.

xiii. The Committee recommended that the first plenary session of the 1958 Annual Meeting be held in Tokyo on Tuesday, November 4th, 1958. Preliminary meetings of the various committees are to be arranged by consultation between their respective Chairmen and the Secretariat. The period beginning on October 20th, 1958 and extending until commencement of the Annual Meeting is to be available for such sessions.

7. PROGRESS IN RESEARCH

In 1957, as in the past, the Commission's research program continued to be concentrated on two principal questions which were defined in the following words in the Annual Report for 1956: *"First,* in accordance with the Protocol to the Convention (to make) an investigation of the waters in the Convention area to determine if there are areas in which salmon originating in the rivers of Canada and the United States intermingle with salmon originating in the rivers of Asia. If such areas are found the Commission is to conduct suitable studies to determine a line or lines which will best divide salmon of Asiatic origin from salmon of North American origin. *Second,* to study the king crab stocks of the eastern Bering Sea, at present fished by Japan and the United States, to determine if joint conservation measures are required."

The research program was outlined in the Annual Report of the Commission for 1954 and restated in the Annual Report for 1956. The Commission's Standing Committee on Biology and Research met in Tokyo during March, 1957, under the Chairmanship of Mr. John H. Clawson of the United States, to study the results of research and to work out detailed plans for 1957 investigations. Scientists of the three countries who specialize in the study of salmon scales for purposes of age determination and stock identification met informally October 23 to 26, at the Pacific Biological Station at Nanaimo, B.C. to study problems of standardization of techniques and application of results to the Commission's research program. The full Committee met again in Vancouver at the University of British Columbia, for the week of October 28, to consider results of research in 1957 in conjunction with data from past years. The meetings continued at intervals between plenary sessions during the following week. Basic plans for 1958 research operations were prepared. Further details will be worked out in advance of the beginning of 1958 operations.

Summaries of research conducted under the Commission's program by each of the three participating countries are presented as Part III of this Annual Report.

The following extract from the Report of the Committee on Biology and Research (Doc. No. 151) as adopted by the Commission at the 1957 Annual Meeting, will give general information on research progress.

STUDIES BEARING ON THE PROTOCOL QUESTIONS

"Work has been continued using the same major techniques of investigation as outlined previously by the Committee: (a) offshore distribution studies, (b) tagging, and (c) racial studies. Substantial progress has been made toward solving the problems posed by the Protocol, although much remains to be learned.

a. Offshore distribution of salmon

"Canada and the United States reported the findings from catches of vessels which carried out experimental fishing on the high seas in 1957. The Canadian results in the Gulf of Alaska gave detailed information on the distribution of the major salmon stocks. Despite a considerably higher temperature of the sea water, the distribution was essentially similar to that reported for 1956. Catches by sunken nets revealed an important new finding: that salmon are distributed considerably more deeply than was previously thought. For pink and chum salmon, per unit area of net, catches at the 20-60 and 40-80 foot levels were sometimes greater than those at the 0-20 foot level; the importance of this finding in evaluating results of surface netting surveys is obvious. The United States reported surveys extending from 160° W. to 175° E., north and south of the Aleutian Islands. The greatest catches of adult red salmon in the areas surveyed by the United States and within the period of the survey were immediately north of the central Aleutian Islands; another striking feature was the great abundance of pink salmon, increasing towards the west.

"Japan reported that analysis of data collected in 1957 from the western North Pacific Ocean was in progress.

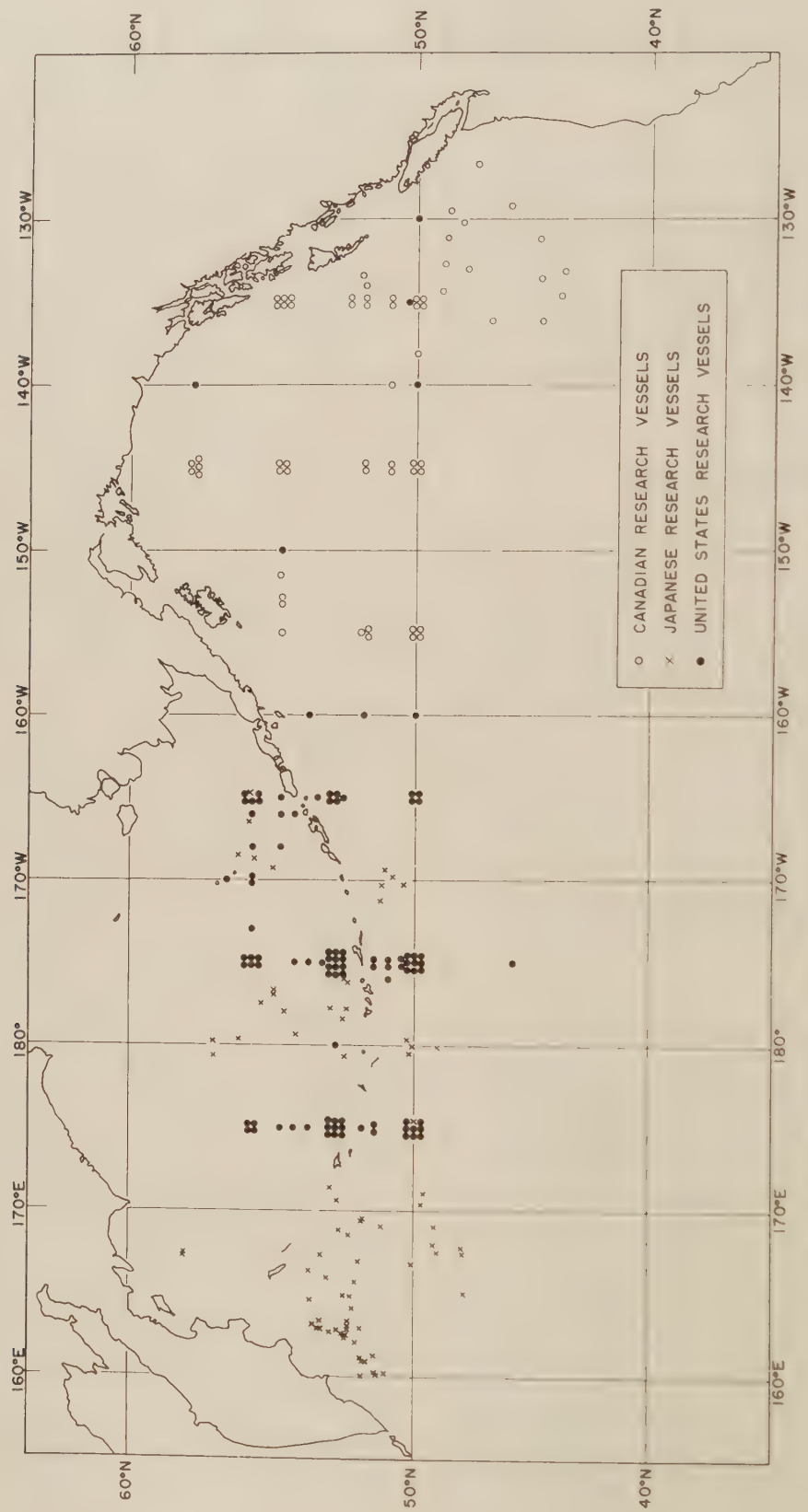

Fig. 1. Fishing stations actually occupied by the research vessels of the three countries, 1957.

b. Tagging

"High-seas tagging in 1957 was much more extensive, both as to area covered and as to numbers of fish tagged, than in 1956. The United States reported the tagging of over 15,000 salmon in an area north and south of the Aleutian Islands from 160° W. to 170° E.

"For the 1957 tagging, recoveries of red salmon were made only in North American inshore waters or in the high-seas fishery. There were no reported recoveries of red salmon along the eastern coast of Kamchatka. In this connection the prohibition of fishing for red salmon in parts of this area at certain seasons was noted, together with the desirability of better information on recoveries in this area. The United States report showed a similar rate of recovery over the area of tagging from east to west and suggested that this indicated that the populations of red salmon tagged consisted mainly of fish from North American streams. In discussion, alternative interpretations were suggested. Recoveries of chum salmon tagged in 1957 reported to date were at sea or near North America but it was noted that in the preceding year recoveries were made from Asian waters later in the year. Pink salmon recoveries were reported to date only from Asian inshore waters and the high seas.

"Also in 1957, there were recoveries from immature red and chum salmon tagged in 1956. For both species the returns to date were from American inshore waters and from the high-seas fishery, but 1957 returns for both the 1956 and 1957 taggings are incomplete.

"Tagging on a much smaller scale was reported by Canada and Japan, with recoveries indicating chiefly movements within local areas.

c. Racial studies

"Work reported was accomplished by four techniques: comparison of parasite infection, analysis of counts of meristic characters, study of blood serum reactions, and comparison of salmon scale sculpture characteristics.

"Canada reported a very extensive investigation of the parasites from some 1,400 red salmon, taken both in streams and on the high seas. Of the 42 species of parasites identified from red salmon, 3 proved particularly valuable in supplying information as to the continental origin of the host fish. The percentage incidence of these three species revealed a shift in predominant forms, proceeding from the samples taken near Asia through the high-seas samples to those taken near North America. Two parasites characteristic of red salmon in Asian waters declined in percentage incidence at longitudes 170°-175° E.; a parasite characteristic of North American fish was predominant from here east to North American waters. This evidence gives indication of an area of mixture of Asian and North American red salmon although further information on life histories and additional sampling are desirable.

"Japan reported that studies of salmon parasites were in progress; results would be furnished in the future.

"The United States reported analysis of counts of seven meristic characters from some 7,000 red salmon. These data were analyzed by a statistical technique resulting in a Generalized Distance Function, the value of the function being proportional to the differences in morphology of the fish. The details of this method have been reported to the other countries in a separate document. Using the area of major red salmon stocks to represent each continent, the values of the meristic counts for the high seas samples were compared with those for the Okhotsk Sea and for Bristol Bay. Results showed a declining value of the function as the sample locality increased in distance from the continental stocks with which the counts were compared. Curves representing the amount of difference crossed between 170° E. and 175° E., indicating about equal numbers of Bristol Bay and Okhotsk Sea salmon in this region, assuming these to be the only stocks present. It was, however, pointed out in discussion that samples from the east coast of Kamchatka should be included in these comparisons to give a complete picture and that such samples have not been available.

"Japan has collected extensive series of data for racial studies. Analysis and interpretation are in progress.

"Tests by United States biologists of blood serum from red salmon taken in North American waters showed the presence of antigens not yet found in samples from Asian waters. Reactions of blood from high-seas samples demonstrated the presence of these antigens as far west as 175° E. It is planned to follow up these preliminary results with more extensive sampling.

"The study of salmon blood is also in progress in Japan and has already indicated some differences between areas.

"It was stated that analysis of the surface sculpture of red salmon scales by United States biologists revealed distinct differences between scales from salmon known to be of North American origin, and those known to be of

Asian origin. It was further stated that by comparison of high-seas scales with those of known continental origin, it was possible to estimate the percentage of Asian and of North American fish in the samples. The estimates were stated to indicate a mixture of North American and Asian red salmon in the area from 165° W. to 165° E., with equal numbers of fish from each continent at about 175° E.

"It was pointed out in discussion that comparison should be made of scales typical of the larger runs from the east coast of Kamchatka with scales representative of Bristol runs in order to obtain a complete picture of the origin of red salmon in the Bering Sea, and that sampling of scales from the Kamchatka Peninsula has been deficient to date.

"In summary the Committee feels that much progress has been made in the research program on the problems raised by the Protocol. It has been established that sockeye, pink and chum salmon of Asiatic and North American origin intermingle in a broad area in the North Pacific and the Bering Sea, apparently extending over at least 30 degrees of longitude between 170° E. and 160° W. Information on the proportions of salmon of Asiatic and North American origin at various times and places within this area of intermingling is being obtained. Studies are somewhat more advanced on sockeye than on pink and chum salmon, although information is also being obtained on the latter two species. Further research is required on all species, using all techniques available.

d. Oceanography

"Canada presented a very thorough review of 1957 hydrographic conditions in the Gulf of Alaska and adjacent waters, based on data from over 60 stations occupied in February and again in August. In general the main features of circulation were similar to 1956; the chief difference was warming of the coastal waters. Observations at year-round oceanographic station "PAPA" revealed the nature of seasonal variation at the surface and in the deeper layers, and showed 1957 winter temperatures to be considerably above normal.

"The United States presented data from sampling stations on meridians 175° E., 175° W. and 165° W. These data, in conjunction with other oceanographic and meteorological data, and with catches of experimental fishing vessels, suggested a relation between salmon distribution and a temperature barrier at about 3°C. Thus higher temperatures in 1957 than in 1956 may have caused an expansion of the area bounded by the barrier, and this may account for the more diffuse distribution of red salmon in the Bering Sea than in 1956.

"Japan reported that its observations are being analyzed, and that reports will be supplied for publication.

"It was noted that annual changes in oceanographic conditions may have great bearing on the distribution of salmon and that observations over a number of years are needed before reliable generalizations can be made regarding the relation of salmon distribution to oceanographic conditions.

RESEARCH ON THE KING CRAB

"The United States presented findings related to the abundance of the crab stocks, and to the biology of the crabs. Data from trawl hauls made at a grid of sampling stations in southeastern Bering Sea, when appropriately adjusted, yielded a population estimate of approximately 25,000,000 commercial-size crabs in the area covered. A similar preliminary estimate resulted from tagging and recovery and further work is planned. Progress is being made in determining growth rates and the effect of ocean currents on larvae.

"Japan reported that tagging experiments, oceanographic observations and biological collections had been carried out. Good progress is being made in the laboratory culture of young crabs. Results of the investigations are being analyzed but are not yet ready to report.

MEETING OF SCIENTISTS ON STUDY OF SCALES

"As proposed at the March, 1957, meeting of the Committee, scientists from Japan, United States and Canada concerned with the study of salmon scales met at Nanaimo, Canada, October 23 to 25, 1957, to discuss interpretation of scale markings for age determinations and for racial studies. Considerable progress was made towards reaching agreement on interpretations and towards standardization of techniques for the collection and examination of scales.

"The Committee agreed to recommend that a similar meeting on scale studies be held in advance of the next annual meeting of the Commission, if convenient.

PLANS FOR RESEARCH IN 1958 ON PROBLEMS RAISED BY THE PROTOCOL

"The Committee reviewed the general aspects of the research program and agreed that, in order to meet the requirements of the Protocol, it is necessary to continue research on a substantial scale. The tentative plans of the three national sections for research in 1958 were reviewed in a general way and working parties requested to develop more definite and detailed proposals. Because the analysis of data and material collected in 1957 has not been completed, the Committee noted that plans formulated now are subject to adjustment in order to make them as effective as possible. Tentative plans are nevertheless detailed in the attached reports of the working parties and can, if desirable, be modified by correspondence on the basis of further analysis of the data obtained to date.

"Plans for 1958 are similar to those carried out in 1957 and include a continuation of work along all the principal lines now in progress. Modifications are proposed in order to improve the overall coverage and to concentrate attention on the areas of special interest. The desirability of obtaining better data and samples of salmon from Asiatic inshore waters and rivers was stressed."

In addition, the Committee on Biology and Research endorsed tentative research plans for 1958 prepared by its sub-committees in relation to the following subjects:

(a) Salmon racial studies and sampling
(b) Salmon tagging
(c) Oceanographic investigations
(d) Fishing by research vessels
(e) Research on king crab in the eastern Bering Sea

The Committee also recommended preparation of annual statistical reports on fisheries of joint interest in the Convention area. The form and content of the reports is to be similar to sample compilations previously prepared by the Secretariat. In addition the Committee recommended a procedure for studying the form and nature of reports submitted by governments under Article III(1)(c)(iii) of the Convention; established details of a procedure for publication of results of scientific investigations carried out under Commission research programs and recommended standardized methods for compilation of oceanographic data. All of these recommendations were approved by the Commission.

8. IMPLEMENTATION OF THE PROVISIONS OF THE CONVENTION

(a) Article III (1) (a)

Article III (1) (a) of the International Convention for the High Seas Fisheries of the North Pacific Ocean requires that the Commission shall study, for the purpose of determining annually, whether any stock of fish specified in the Annex to the Convention continues to qualify for abstention under the provisions of Article IV. The stocks listed in the Annex to the Convention are (a) halibut in the Convention area off the coasts of Canada and the United States of America; (b) herring in the Convention area off the coasts of Canada and the United States, exclusive of the Bering Sea and of the waters of the North Pacific Ocean west of the meridian passing through the extremity of the Alaskan peninsula; (c) salmon (of the five North American species) in the Convention area off the coasts of Canada and the United States, exclusive of the Bering Sea and of the waters of the North Pacific Ocean west of the provisional line which follows the meridian passing through the western extremity of Atka Island (approximately 175°W.); (d) salmon (of the five North American species) in the Convention area of the Bering Sea, east of the provisional line described in the Annex. Japan has agreed to abstain from fishing all the above stocks. Canada has agreed to abstain from fishing salmon in the Bering Sea (d, above) east of the provisional line which, for its greater part, coincides with the meridian of 175°W.

The exact wording of Article III, Section (1), paragraph (a) of the Convention is as follows:

"1. The Commission shall perform the following functions:

> "(a) In regard to any stock of fish specified in the Annex, study for the purpose of determining annually whether such stock continues to qualify for abstention under the provisions of Article IV. If the Commission determines that such stock no longer meets the conditions of Article IV, the Commission shall recommend that it be removed from the Annex. Provided, however, that with respect to the stocks of fish originally specified in the Annex, no determination or recommendation as to whether such stock continues to qualify for abstention shall be made for five years after the entry into force of this Convention."

Article IV of the Convention, to which reference is made above, reads as follows:

"1. In making its recommendations the Commission shall be guided by the spirit and intent of this Convention and by the considerations below mentioned.

(a) Any conservation measures for any stock of fish decided upon under the provisions of this Convention shall be recommended for equal application to all Parties engaged in substantial exploitation of such stock.

(b) With regard to any stock of fish which the Commission determines reasonably satisfies all the following conditions, a recommendation shall be made as provided for in Article III, Section 1 (b).

(i) Evidence based upon scientific research indicates that more intensive exploitation of the stock will not provide a substantial increase in yield which can be sustained year after year.

(ii) The exploitation of the stock is limited or otherwise regulated through legal measures by each Party which is substantially engaged in its exploitation, for the purpose of maintaining or increasing its maximum sustained productivity; such limitations and regulations being in accordance with conservation programs based upon scientific research, and

(iii) The stock is the subject of extensive scientific study designed to discover whether the stock is being fully utilized and the conditions necessary for maintaining its maximum sustained productivity.

"Provided, however, that no recommendation shall be made for abstention by a Contracting Party concerned with regard to: (1) any stock of fish which at any time during the twenty-five years next preceding the entry into force of this Convention has been under substantial exploitation by that Party having regard to the conditions referred to in Section 2 of this Article; (2) any stock of fish which is harvested in greater part by a country or countries not party to this Convention; (3) waters in which there is historic intermingling of fishing operations of the Parties concerned, intermingling of the stocks of fish exploited by these operations, and a long-established history of joint conservation and regulation among the Parties concerned so that there is consequent impracticability of segregating the operations and administering control. It is recognized that the conditions specified in subdivision (3) of this proviso apply to Canada and the United States of America in the waters off the Pacific Coasts of the United States of America and Canada from and including the waters of the Gulf of Alaska southward and, therefore, no recommendation shall be made for abstention by either the United States of America or Canada in such waters.

"2. In any decision or recommendation allowances shall be made for the effect of strikes, wars, or exceptional economic or biological conditions which may have introduced temporary declines in or suspension of productivity, exploitation, or management of the stock of fish concerned."

It should be noted that Article III(1)(a) provides that, for stocks originally specified in the Annex, no determination or recommendation as to whether such stock continues to qualify for abstention shall be made for five years after the entry into force of the Convention (June 12, 1953). In order to establish an orderly and comprehensive procedure for determining whether or not the stocks specified in the Annex continue to qualify for abstention under the provisions of Article IV, the Commission adopted the following resolution at its 1955 Annual Meeting:

> "In order to enable this Commission to carry out its responsibility for determining whether stocks of fish specified in the Annex continue to qualify for abstention pursuant to Article III of the Convention, the following procedure is proposed: the Commission should request each Contracting Party which is managing, or participating in the management of, an abstained stock of fish, to submit to the Commission at the 1956 Annual Meeting, a report, with supporting data, concerning the management of such stock of fish, giving attention particularly to the requirements for abstention. The Commission would then have the opportunity of studying these reports and data and request and receive any needed supplementary data at the 1957 Annual Meeting, following which it would study the entire body of information in time to make its determination at its first Annual Meeting following the fifth anniversary of this Convention in 1958."

At the 1956 Annual Meeting the United States and Canada each submitted to the Commission the reports called for by the above resolution. A committee, called the Ad Hoc Committee for Study of Reports Submitted

Under Article III(1)(a), was established at the 1956 Annual Meeting to study the reports, obtain, to the extent possible, on-the-spot clarification of obscure points, if any, and to determine whether or not further information should be requested.

The Ad Hoc Committee met in Tokyo from March 11 to 14, 1957, studied the reports, and recommended to the Commission that a number of items of additional information be requested from the Governments of Canada and the United States. The Commission subsequently approved the report of its committee and requested the Contracting Parties to supply the additional information.

The Ad Hoc Committee next met in the week preceding the 1957 Annual Meeting of the Commission. At that time the process of study and clarification of the reports was continued. The Commission, by that time, had received certain of the items of additional information requested from the Governments of Canada and the United States. Other items of additional information, requiring more extensive preparation and compilation, were transmitted at the 1957 Annual Meeting. Certain items of information requested from the United States were still outstanding at the conclusion of the 1957 Annual Meeting.

The Commission referred Items 10 and 11 of its agenda for the plenary sessions of the 1957 Annual Meeting to the Ad Hoc Committee for Study of Reports Submitted Under Article III(1)(a). The outline given above briefly illustrates progress toward implementation of Article III(1)(a), in accordance with Item 10 of the Agenda. With respect to Item 11 of the Agenda, "Consideration of further steps toward implementation of Article III(1)(a) of the Convention", also referred to the Ad Hoc Committee, the following report (INPFC Doc. No. 155) was submitted to the Commission and adopted at the fifth plenary session on November 8, 1957:

> "The Ad Hoc Committee for Study of Reports Submitted Under Article III(1)(a), as appointed at the Third Annual Meeting of the Commission, held meetings on November 1st, 5th and 7th, 1957. The Ad Hoc Committee reports as follows on Item 11 of the Agenda of the 1957 Annual Meeting, which reads as follows: "Consideration of further steps toward implementation of Article III(1)(a) of the Convention".
>
> "It is recommended to the Commission that the Ad Hoc Committee should continue its work under the following amended terms of reference:
>
> "1. That the Ad Hoc Committee study the reports submitted by the Governments with respect to Article III(1)(a);
>
> "2. That the Ad Hoc Committee study any additional subject or information relating to Article III(1)(a) submitted to it by any national section;
>
> "3. That the Ad Hoc Committee study all aspects of the problems or subjects relating to Article III(1)(a) coming before it;
>
> "4. That the Ad Hoc Committee shall prepare for submission to the Commission a report regarding the determinations provided under Article III(1)(a) as well as reports on any other subjects or information relating to Article III(1)(a) which may come before the Committee;
>
> "5. That the Ad Hoc Committee shall function under its new terms of reference immediately following the close of the Fourth Annual Meeting of the Commission and that meetings of the Ad Hoc Committee shall be held at appropriate times and places as may be decided by the Committee."

(b) Article III(1)(c)(i)

Under Article III(1)(c)(i) of the Convention, at the request of the United States, the Commission has undertaken a study of the king crab stocks of the eastern Bering Sea for the purpose of determining if joint conservation measures are needed. The excerpt from the report of the Committee on Biology and Research, page 8 of this Annual Report, gives a brief summary of progress in king crab investigations. The results of research to date are considered to be highly encouraging. Preliminary estimates of population size and the growth and mortality rates are being obtained. Plans for 1958 emphasize further studies of growth rates, migration habits, fishing mortality, seasonal variations in quantity and quality of crab meat, assessment of damage by fishing gear of various types, studies of hydrography of the area, studies of early life history, collection of catch statistics and general ecological studies. Scientists from the United States and Japan are conducting these investigations.

(c) The Protocol to the Convention

In 1954 the Commission gave to its Committee on Biology and Research the continuing assignment of planning and conduct of research required as a basis for fulfilment of the terms

the Protocol to the Convention. Progress in the research phase of the implementation of the Protocol is described in the excerpt from the report of the Committee on Biology and Research, beginning on page 5 of this Annual Report. Attention is drawn to the summary of the report by the Committee on Biology and Research as given on page 8.

In addition to planning the further research which is required in connection with the Protocol, the Commission took action at the 1957 Annual Meeting on a proposal made by the United States with the objective of applying the results of research to adjustment of the provisional lines in accordance with the terms of the Protocol. The following four paragraphs summarize the action taken.

At the first plenary session the United States Section proposed that an ad hoc committee be appointed immediately to undertake a study of the problem of determining the line or lines which most equitably divide salmon originating on the two sides of the Pacific Ocean and that the committee report its findings and recommendations at the earliest possible date.

At the second plenary session, in adopting its Agenda, the Commission agreed in principle that a new item would be added to the Agenda to permit consideration of the proposal by the United States to establish an ad hoc committee to deal with some aspects of the Protocol problem. Subsequently, at the same plenary session, a new item, No. 17, was added to the Agenda. The item read as follows: "Consideration of a proposal to appoint an ad hoc committee to consider application of the results of research to adjustment of the provisional lines in accordance with the terms of the Protocol."

At the fifth and final plenary session all national sections of the Commission agreed to give consideration to Agenda Item 17. The Commission then proceeded to establish the ad hoc committee proposed in the above Agenda item on the conditions expressed by the Japanese Section, that details for establishment of the committee should be discussed at the next annual meeting and that there were as yet no results of research suitable for application in connection with the implementation of the Protocol.

The Commission also agreed that the new ad hoc committee would meet in Vancouver on the day following the adjournment of the 1957 Annual Meeting to discuss its organization and exchange views on its future activities, subject to the conditions expressed above.

9. OTHER MATTERS

At the first plenary session of the 1957 Annual Meeting the spokesman for the United States Section voiced serious apprehension over the capture of sockeye salmon of American origin by the Japanese high-seas fishing fleet in the area of intermingling of stocks west of the provisional abstention line. The views of the United States Section in this matter are briefly summarized on page 1 of this Annual Report. The United States Section expressed the view that the problem of adjustments of the location of the provisional lines was sufficiently difficult to make adjustment of the provisional line in accordance with the terms of the Protocol uncertain of completion prior to the next (1958) fishing season. The United States Section therefore considered it essential that some interim steps should be taken by the Parties to the Convention without delay and proposed, pending an appropriate change in the provisional lines, that the Commission should recommend to the respective Contracting Parties that the adverse effect of fishing in the area of intermingling be minimized by cessation of fishing in areas where, or at times when, a substantial proportion of salmon of North American origin are found.

At the fifth plenary session, under Agenda Item 19, "Other Business," the United States Section recorded in the minutes its views on the unexpected decrease in return of sockeye salmon to the United States fishery in Bristol Bay in 1957, and related the unexpectedly low return of red salmon to the presence of a heavy concentration of Japanese high-seas fishing vessels in areas west of 175° W., in which areas high-seas sampling showed large numbers of fish of probable North American origin were present. The United States Section then requested consideration of its proposal to establish in advance of the 1958 season a zone in which there would be a cessation of all fishing in waters where a substantial proportion of salmon of North American origin are found. The United States Section considered such protection essential to meet its obligations through sound management practices to perpetuate the Alaska salmon fisheries on a sustained yield basis.

The Japanese Section was confident that Japan would give full consideration to necessary and appropriate measures for the conservation of salmon resources in the North Pacific area, even though they may not be required by the provisions of the Convention. However, the Japanese Section did not feel that the United States proposal was a suitable subject for formal discussion.

The Canadian Section also expressed its continuing deep concern for conservation of the fisheries resources of the North Pacific Ocean and could understand the apprehensions of the United States Section. However, the Canadian Section felt that direct evidence to date did not show that all of the species of salmon concerned were involved in the problem presented by the United States Section. The Canadian Section also felt that the establishment of the Second Ad Hoc Committee to commence immediate consideration of the Protocol problems was another step on the way to resolving the question. Therefore, the Canadian Section felt that the United States Section's proposal should not be debated extensively at the present meeting of the Commission.

In concluding the discussion on the question of whether or not the proposal of the United States Section should be considered by the Commission, the Chairman, Mr. George R. Clark of Canada, expressed the view that the proposal should not be debated further and suggested that the immediate problem should be discussed at another level and perhaps through other channels of the Contracting Parties to the Convention. He called attention to the general obligation assumed by all three nations under the Convention to strive for the development of the maximum sustained production from the fishery resources of the North Pacific Ocean through mutual efforts at conservation and regulation.

Since unanimous agreement by all three national sections was required before the subject could be placed on the agenda for discussion, no action on the proposal was possible.

10. ELECTION OF OFFICERS

Following the system of rotation given in the Rules of Procedure, Mr. Iwao Fujita of Japan was elected as Chairman of the Commission for the next year. Mr. Edward W. Allen of the United States was elected as Vice-Chairman and Mr. George R. Clark of Canada was elected as Secretary. All officers of the Commission and Chairmen of Committees, unless otherwise noted, take office immediately upon adjournment of the annual meeting and end their terms at the conclusion of the next annual meeting.

Mr. James C. Cameron of Canada was chosen as Chairman of the Committee on Biology and Research. Mr. Ross L. Leffler of the United States was elected as Chairman of the Committee on Finance and Administration. Mr. George R. Clark of Canada was chosen by the Ad Hoc Committee for Study of Reports Submitted Under Article III(1)(a) as its Chairman until the beginning of the next meeting of the Committee. Membership of the two standing committees for the ensuing year was left unchanged from that given in the list of participants which forms Appendix I of this report. Membership of the Ad Hoc Committee for Study of Reports Submitted Under Article III (1)(a) is also given in Appendix I.

11 FUTURE MEETINGS

The fifth annual meeting of the Commission will be convened in Tokyo on November 4th, 1958. Meetings of the various committees will be arranged by correspondence between the respective Chairmen and the Secretariat. It was agreed that the period beginning on October 20th, 1958, and extending until the convening of the plenary sessions on November 4th would be available for scheduling of committee meetings.

APPENDIX I

List of Participants

OFFICERS OF THE MEETING

CHAIRMAN
George R. Clark, Canada

VICE-CHAIRMAN
Iwao Fujita, Japan

SECRETARY
Edward W. Allen, United States

MEMBER GOVERNMENTS

CANADA

Commissioners

John M. Buchanan,
Vancouver, B.C.

James C. Cameron,
Madeira Park, B.C.

George R. Clark,
Ottawa, Canada

Roger T. Hager,
Vancouver, B.C.

Advisers and Experts

T. H. Bilton
A. J. Dodimead
R. E. Foerster
H. Godfrey
J. L. Kask
K. S. Ketchen
R. J. LeBrasseur
J. I. Manzer
L. Margolis
F. Neave
A. W. H. Needler
M. F. Ronayne
M. P. Shepard
W. M. Sprules
F. H. C. Taylor
J. P. Tully
H. Christenson
W. R. Hourston
G. G. Kidd
C. J. Levelton
O. J. McDonald
F. Probert
W. E. Ricker
T. Sorenson
R. Stanton (Alternate, L. Carr)
H. Stevens (Alternates, T. Parkin T. Suzuki)
L. G. Swann
G. T. Taylor
R. E. Walker
A. J. Whitmore

JAPAN

Commissioners

Iwao Fujita,
Tokyo, Japan

Koh Chiba,
Tokyo, Japan

Kenjiro Nishimura,
Tokyo, Japan

Kyuhei Suzuki,
Tokyo, Japan

Advisers and Experts

Motosaku Fujinaga
Yoshiharu Takeno
Muneo Tanabe
Keisuke Arita
Tomonari Matsushita
Hiroshi Ohki
Chusei Yamada
Toshio Isogai
Kisaburo Taguchi
Takeo Ito

UNITED STATES

Commissioners

Milton E. Brooding,
San Francisco, California
Edward W. Allen,
Seattle, Washington
John H. Clawson,
Anchorage, Alaska
Ross L. Leffler,
Washington, D.C.

Advisers

C. E. Atkinson
Isla V. Davies
R. Fredin
W. C. Herrington
D. P. Loker
D. L. McKernan
W. M. Terry
A. L. Tester
W. F. Thompson

Advisory Committee

C. L. Anderson
W. C. Arnold
R. S. Croker
DeWitt Gilbert
M. C. James
J. Hodges
G. Johansen
R. C. Kallenberg
H. E. Lokken
M. Moore
C. Pautzke
M. Phister
J. W. Smith
L. Wakefield
J. Waugh

Experts

F. C. Cleaver
F. Favorite
F. Fukuhara
J. T. Gharrett
M. G. Hanavan
T. Miyahara
K. H. Mosher
A. E. Peterson
G. Ridgway
W. Royce
R. P. Silliman
R. J. Tepper
J. Uzman

OBSERVERS

International Pacific Salmon Fisheries Commission
L. A. Royal

Great Lakes Fishery Commission
N. S. Baldwin

International Pacific Halibut Commission
H. Helland
H. A. Dunlop
F. H. Bell

International Commission for the Northwest Atlantic Fisheries
G. R. Clark

SECRETARIAT

Permanent.

Roy I. Jackson,
Executive Director

Hiroshi Kasahara,
Assistant Director

Anne Waters,
Secretary

Temporary.

D. F. Alderdice
B. Campbell
June Dytor
W. F. Miller
Elsie Paulson
Ethel Robinson
M. F. Ronayne
W. G. Van Campen

MEMBERSHIP OF STANDING COMMITTEES

Standing Committee on Finance and Administration

CANADA
Commissioner.....Roger T. Hager
Adviser.....George R. Clark

JAPAN
Commissioner.....Iwao Fujita, Chairman
Adviser.....Kenjiro Nishimura

UNITED STATES
Commissioner.....Ross L. Leffler
Advisers.....Donald P. Loker
Isla V. Davies

SECRETARIAT
Roy I. Jackson
Hiroshi Kasahara

Standing Committee on Biology and Research

CANADA
Commissioner.....James C. Cameron
Advisers.....A. W. H. Needler, Convenor
R. E. Foerster

JAPAN
Commissioner.....Kyuhei Suzuki
Advisers.....M. Fujinaga
K. Taguchi

UNITED STATES
Commissioner.....John H. Clawson, Chairman
Advisers.....A. L. Tester
W. F. Thompson

SECRETARIAT
Roy I. Jackson
Hiroshi Kasahara

AD HOC COMMITTEE FOR STUDY OF REPORTS SUBMITTED UNDER ARTICLE III(1)(a)

CANADA

Commissioner-member	George R. Clark, Chairman
Commissioner-adviser	James C. Cameron
Advisers	A. W. H. Needler
	K. S. Ketchen
	M. P. Shepard
	W. M. Sprules

JAPAN

Commissioner-member	Iwao Fujita
Commissioner-advisers	Kenjiro Nishimura
	Kyuhei Suzuki
Advisers	M. Fujinaga
	K. Taguchi
	T. Matsushita
	K. Arita
	M. Tanabe
	H. Ohki
	C. Yamada
	T. Ito
	T. Isogai

UNITED STATES

Commissioner-member	Edward W. Allen
Commissioner-adviser	Milton E. Brooding
Advisers	D. L. McKernan
	C. E. Atkinson
	W. C. Herrington
	W. M. Terry
	R. Fredin
	T. Miyahara
	R. C. Kallenberg

APPENDIX II

AGENDA

as adopted at the

ANNUAL MEETING — 1957

Vancouver, British Columbia, November 4 to 8, 1957

1. Call to order by the Chairman.
2. Introductions—including observers.
3. Addresses of welcome and responses.
4. Adoption of Agenda.
5. Submission of lists of delegation members and designation of committee members by national sections.
6. Establishment of procedures for the meeting.
   (a) Attendance at meetings.
   (b) Press policy.
   (c) Minutes.
7. Report of the Chairman.
8. Report of the Secretary.
9. Reports by the Executive Director, including:
   (a) Accounts.
   (b) Budgets.
   (c) Administrative matters.
   (d) Penalties for violations of the Convention. (Article III (1) (d)).
   (e) Form and nature of reports submitted under Article X (2) of the Convention.
10. Consideration of progress toward implementation of the provisions of Article III (1) (a) of the Convention.
11. Consideration of further steps toward implementation of Article III (1) (a) of the Convention.
12. Report of the Ad Hoc Committee for Study of Reports Submitted under Article III (1) (a).
13. Consideration of the implementation of the provisions of the Convention:
    Progress and plans re:
    (a) Protocol to the Convention.
    (b) Article III (1) (c) (i) and (ii)—(King Crab).
    (c) Article III (1) (c) (iii)—(form and nature of reports).
    (d) Article III (1) (e)—(Statistics).
    (e) Publication of scientific reports.
14. Report of the Committee on Biology and Research.
15. Consideration of administrative and fiscal matters.
    (a) Accounts and Auditor's Report.
    (b) Policy for publication of scientific reports.
    (c) Pension program for staff members.
    (d) Response to invitation to send observer to conference on law of the sea.
    (e) Schedule of meetings for forthcoming year.
    (f) Budget for fiscal year beginning July 1, 1958.
    (g) Budget forecast for fiscal year beginning July 1, 1959.
    (h) Adoption of formal recommendations to the Contracting Parties re:
        (i) Research programs.
        (ii) Budget contributions.
        (iii) Reports for information.
        (iv) Other matters.
    (i) Other business.
16. Report of the Committee on Finance and Administration.
17. Consideration of a proposal to appoint an ad hoc committee to consider application of the results of research to adjustment of the provisional lines in accordance with the terms of the Protocol.
18. Election of officers and determination of membership of committees.
19. Other business.
20. Adjournment.

II. Administrative Report for 1957

by the Executive Director

ROY I. JACKSON

This report contains information on fiscal and administrative matters and a record of the principal activities of the Secretariat of the International North Pacific Fisheries Commission for the period beginning with the close of the 1956 Annual Meeting of the Commission on November 16, 1956, and ending with the close of the 1957 Annual Meeting on November 8, 1957.

1. Officers and Staff

At the closing session of the 1956 Annual Meeting following the rotation principle established in Rule of Procedure 13, the following were elected as officers of the Commission for the period beginning with adjournment of the 1956 Annual Meeting and ending upon adjournment of the 1957 Annual Meeting: Chairman, Mr. George R. Clark of Canada; Vice-Chairman, Mr. Iwao Fujita of Japan; Secretary, Mr. Edward W. Allen of the United States. For the same term, Mr. John H. Clawson of the United States was elected Chairman of the Standing Committee on Biology and Research and Mr. Iwao Fujita of Japan was elected as Chairman of the Standing Committee on Finance and Administration.

Mr. R. I. Jackson continued as the Commission's Executive Director and Dr. H. Kasahara as Assistant Director.

2. Accounts and Audit

The report of the Commission's auditors, Peat, Marwick, Mitchell and Co., for the financial year ended June 30, 1957, is appended to this report. The auditors found that the accounts and fiscal procedures of the Secretariat were in good order.

Receipts from the three Contracting Parties for the period totalled $38,510.35 in United States funds. Each government contributed equally, except for an overpayment of 35 cents by one of the Contracting Parties. In this fiscal period the Financial Regulations continued to require that appropriations be paid in United States funds while accounts and expenditures were in Canadian funds. For that reason the semi-annual contributions from the various governments were subject to varying discount rates, depending upon the date of their receipt. The total discount amounted to $1,227.42, an average rate of 3.19%. The net appropriation available in Canadian funds was $37,282.93. There was no surplus available from the 1955-56 financial period. The amount of $2,710.05, Canadian funds, was held over into the 1957-58 fiscal period for accounts payable and accrued expenses from the 1956-57 fiscal period. These accounts have now been paid and there is no surplus from 1956-57 appropriations.

At the 1956 Annual Meeting the Commission amended its Financial Regulations to provide that appropriations should be payable in the currency of the headquarters country, i.e., Canada. The first semi-annual contribution from each country for headquarters operation in the 1957-58 financial year has been received. These payments, amounting to $6,538.33 each, were made in Canadian funds, in accordance with the amended Financial Regulations.

At the suggestion of the auditors, and as recommended by the Committee on Finance and Administration and approved by the Commission at the 1956 Annual Meeting, a blanket bond covering all staff members in the amount of $25,000 has replaced the bond on the Executive Director alone. Also, the Commission's equipment has been insured against loss in the amount of $4,750.

3. Working Capital Fund

The Working Capital Fund, amounting to $5,864.75, Canadian funds, was not used during the fiscal period 1956-57. Interest received, amounting to $54.67, was credited to the General Fund upon advice of the auditors.

4. Votes

During the period which has elapsed since the close of its 1956 Annual Meeting the Commission has voted by correspondence on several questions. The decisions and the dates on which they were announced or otherwise took effect are as follows:

a. Draft minutes of the final plenary session of the 1956 Annual Meeting were approved by all national sections and distributed in final form on February 9, 1957.

b. Draft minutes of the two *in camera* sessions held by the Commission during the 1956 Annual Meeting were approved by vote by correspondence. Approval was announced in Circular Letter No. 1 from the Secretariat, dated February 20, 1957.

c. All national sections signified their approval for publication of the draft manuscript of the 1956 Annual Report. The latest approval was received on July 3, 1957.

d. The First Report of the Ad Hoc Committee For Study of Reports Submitted Under Article III(1)(a), which was prepared at the Committee's interim meeting, held in Tokyo, March 11 - 14, 1957, was mailed to all national sections for approval. Approval by all national sections was announced in the Secretariat's Circular Letter No. 10, dated July 5, 1957.

e. The Standing Committee on Biology and Research held an interim meeting in Tokyo from March 18 - 23, 1957. The report of the meeting was submitted to all national sections of the Commission for approval which was received and announced in Circular Letter No. 11, dated July 30, 1957.

f. The Commission approved the issuing of invitations to the following organizations to send observers to the 1957 Annual Meeting of the Commission and its standing committees:

The Union of Soviet Socialist Republics
Food and Agriculture Organization of the United Nations
International Pacific Halibut Commission
International Pacific Salmon Fisheries Commission
International Commission for the Northwest Atlantic Fisheries
Inter-American Tropical Tuna Commission
Great Lakes Fishery Commission

5. Changes in Membership of the National Sections

Mr. Sakari Masuda and Mr. Kenkichi Nakabe of Japan resigned as Commissioners on January 28, 1957, and were succeeded on the same date by Mr. Masao Okai and Mr. Kyuhei Suzuki, respectively.

Mr. Masao Okai of Japan resigned from the Commission on August 31, 1957, and was replaced by Mr. Hideo Okuhara on October 1, 1957.

Mr. Hideo Okuhara of Japan resigned from the Commission on October 11, 1957, and was succeeded, on the same date, by Mr. Kenjiro Nishimura.

Mr. John L. Farley of the United States resigned from the Commission on February 8, 1957. He was succeeded by Mr. Ross L. Leffler on September 30, 1957.

6. Reports

At the close of the 1956 Annual Meeting bound copies of the minutes and related meeting documents, in English, were prepared and distributed to all participants. The Japanese-language version of these records is in the course of preparation.

The Japanese version of the Annual Report for 1955 and the English version of the Annual Report for 1956 were printed and distributed.

The English version of a handbook containing the Convention, Rules of Procedure and Financial Regulations of the Commission has been prepared and printed. Arrangements for translation and printing in Japanese are under way.

Several newsletters containing information on activities of interest to the Commission have been prepared and distributed.

No scientific bulletins were issued by the Commission during the period.

7. Interim Meetings

The Ad Hoc Committee For Study of Reports Submitted Under Article III(1)(a) met in Tokyo from March 11 to 14, 1957. Mr. George R. Clark of Canada was chosen as Chairman of the Committee for the period of its meeting. A report of the meeting was prepared by the Committee and submitted to the Commission for approval by correspondence. Following approval of the report, the Secretary of the Commission requested that the governments of Canada and the United States supply the Commission with certain additional information regarding stocks of fish listed in the Annex to the Convention. A portion of this information has been received and distributed to Commission members. More of the requested additional data is expected to be submitted either prior to or during the 1957 Annual Meeting.

At the interim meeting of the Ad Hoc Committee plans were made to meet again prior to the 1957 Annual Meeting in order to allow the Japanese members more time to study the reports already submitted and to develop additional questions and requests for clarification.

The Standing Committee on Biology and Research held an interim meeting in Tokyo during the period March 18 - 23, 1957. Chairman of the meeting was Mr. John H. Clawson, United States; Dr. Motosaku Fujinaga of Japan acted as convenor of the scientists. The Committee studied progress in research under the Commission's program through 1956 and worked out details of research plans and co-ordination procedures for 1957, following general plans and policies established by the Commission at earlier meetings. The report of the Committee's meeting was distributed to the Commission and approved by correspondence vote. A number of individual reports on research in progress were submitted by the various participants in the meeting. These reports have been made part of the Commission's official files.

8. Staff Matters

In November, 1956, the Executive Director attended the Annual Meeting of the Pacific Marine Fisheries Commission, held in San Francisco. Problems of general interest to this Commission were discussed by the group. In March, 1957, the Director and Assistant Director attended the meetings of the Ad Hoc Committee and the Committee on Biology and Research, held in Tokyo. In May the Director travelled to Ottawa to discuss Commission matters with the Chairman, and visited United States fisheries officials in Washington, D.C., on the same trip. During July the Director made a brief visit to fishing areas and research centres in Bristol Bay and Anchorage, stopping at Juneau while en route home to talk with U.S.F.W.S. officials.

In August the Assistant Director inspected fish facilities, hatcheries and research centres along the Columbia River. The Director travelled to Ottawa to work out detailed arrangements for the 1957 Annual Meeting with the Commission's Chairman. During September the Assistant Director presented a paper at the Eighth Annual Alaska Science Conference in Anchorage, Alaska.

At various times during the year the Director and Assistant Director have visited the laboratories conducting research for the Commission in Seattle and Nanaimo to discuss progress in investigations and assist in co-ordination of various phases of the work.

A new building for the Vancouver Technological Laboratory of the Fisheries Research Board of Canada is now under construction on the campus of the University of British Columbia. Upon its completion, possibly by mid-1958, the Commission's staff will occupy a portion of the new quarters.

At the Commission's headquarters in Vancouver the staff has carried on its normal activities in assisting the Commission in the conduct of its business. This includes the compilation and preparation of statistical reports; drafting of portions of the Annual Report; preparation of minutes, committee reports and newsletters; transmittal of documents and reports; preparation of meeting documents and plans and continuous correspondence in connection with the Commission's affairs and programs. A special report on research vessel gear in 1956; a report on penalties for violations of the Convention and comments on the form and nature of the reports submitted under Article X(2) of the Convention have been prepared.

9. Budget Estimates

As required by the Financial Regulations, budget estimates for 1958-59 and a budget forecast for 1959-60 were prepared in consultation with the Chairman of the Commission. The estimates and forecast were distributed to all members of the Commission sixty days in advance of the 1957 Annual Meeting. Budget estimates and appropriations are now made in Canadian funds, in accordance with the amended Financial Regulations.

APPENDIX I

PEAT, MARWICK, MITCHELL & CO.
CHARTERED ACCOUNTANTS
410 SEYMOUR STREET
VANCOUVER 2, B.C.

AUDITOR'S REPORT TO THE COMMISSION

We have examined the balance sheet of the International North Pacific Fisheries Commission as of June 30, 1957, and the statements of income and expenditure and receipts and disbursements for the year ended on that date and have obtained all the information and explanations we have required. Our examination included a general review of the accounting procedures and such tests of accounting records and other supporting evidence as we considered necessary in the circumstances.

In our opinion the balance sheet and statements of income and expenditure and receipts and disbursements are properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Commission at June 30, 1957, and the results of its operations for the year ended on that date, according to the best of our information and the explanations given to us and as shown by the books of the Commission.

PEAT, MARWICK, MITCHELL & CO.,
Chartered Accountants.

Vancouver, B. C.,
July 25, 1957.

Statement of Assets and Liabilities
June 30, 1957

(Stated in Canadian Funds)

ASSETS

General funds:		
Cash in bank		$ 2,285.05
Deposit with United Air Lines		425.00
		$ 2,710.05
Working capital fund:		
Cash in bank		5,864.75
Equipment, at cost	$ 4,545.68	
Less accumulated depreciation	1,022.61	
		3,523.07
		$12,097.87

LIABILITIES

General funds:		
Accounts payable and accrued expenses		$ 2,710.05
Advances from contracting parties for working capital fund		5,864.75
Amount equivalent to expenditure on equipment less depreciation, per contra:		
Amount at June 30, 1956	$ 3,857.74	
Additions during the year	687.94	
	$ 4,545.68	
Deduct:		
Depreciation provided in previous years $ 568.04		
Depreciation in current year 454.57		
	1,022.61	
		3,523.07
		$12,097.87

Statement of Income and Expenditures

Year ended June 30, 1957

(Stated in Canadian Funds)

Income:		
Contributions from contracting parties (U. S. funds $38,510.35)		$37,282.93
Expenditures:		
Personal services	$22,962.47	
Travel	5,092.20	
Transportation of things	6.75	
Communications	958.07	
Rent and utilities	1,500.00	
Other contractual services	3,630.42	
Supplies	1,412.69	
Equipment	687.94	
Cost of annual meeting	1,032.39	
		$37,282.93

STATUS OF APPROPRIATIONS

	Budget Appropriations U.S. Funds	Appropriations as modified by transfers U.S. Funds (Note 1)	Appropriations as modified by transfers Canadian Funds (Note 2)	Expenditures
Personal services	$23,130.00	$23,718.40	$22,962.47	$22,962.47
Travel	6,500.00	5,259.85	5,092.20	5,092.20
Transportation of things	100.00	6.97	6.75	6.75
Communications	800.00	989.61	958.07	958.07
Rents and utilties	1,530.00	1,549.38	1,500.00	1,500.00
Other contractual services	3,000.00	3,749.95	3,630.42	3,630.42
Supplies	800.00	1,459.20	1,412.69	1,412.69
Equipment	1,800.00	710.60	687.94	687.94
Cost of annual meeting	850.00	1,066.39	1,032.39	1,032.39
	$38,510.00	$38,510.35	$37,282.93	$37,282.93

Notes:

(1) The small difference in total appropriations arose from an overpayment by one of the contracting parties.

(2) Converted at the average rate of exchange realized.

Statement of Receipts and Disbursements

Year ended June 30, 1957

(Stated in Canadian Funds)

Receipts:		
Contributions from contracting parties (U. S. funds $38,510.35)		$37,282.93
Disbursements:		
Personal services	$22,962.47	
Travel	5,092.20	
Transportation of things	6.75	
Communications	958.07	
Rent and utilities	1,500.00	
Other contractual services	2,910.24	
Supplies	1,412.69	
Equipment	687.94	
Cost of annual meeting	1,032.39	
		36,562.75
Excess of receipts over disbursements, represented by increase in bank accounts:		
Balance June 30, 1957	$ 8,149.80	
Balance June 30, 1956	7,429.62	
		$ 720.18

III. The Research Program of the North Pacific Fisheries Commission

A. PROGRESS IN 1957 IN CANADIAN RESEARCH ON PROBLEMS RAISED BY THE PROTOCOL

Canada's part in 1957 in the Commission's program of research on problems raised by the Protocol includes: (1) high-seas fishing to study salmon distribution and obtain samples; (2) studies of skeletal anatomy of salmon, of the parasites of sockeye and pink salmon and of salmon scales, to distinguish stocks of various river origins and discover their distribution on the high seas; and (3) study of the oceanography of the North Pacific to provide background for understanding salmon movements, and distribution. Canada also co-operated in other phases of the Commission's research program by provision of material for study by the United States and Japan and by efforts to recover tags placed on salmon on the high seas. Special fishing and tagging of young salmon leaving their rivers of origin was discontinued pending returns which will indicate the effectiveness of the tagging of the small fish.

1. HIGH-SEAS FISHING TO STUDY DISTRIBUTION AND OBTAIN SAMPLES

In 1957 the chartered vessels *Key West II* and *Fort Ross* carried out gill-net fishing in the North Pacific between May 13 and August 28. In accordance with plans developed at the March, 1957, meeting of the Committee on Biology and Research at Tokyo, fewer stations were occupied than in 1956 but more intensive fishing was carried out at each in order to obtain larger samples. Fishing was concentrated at or near seven primary stations in the Gulf of Alaska west to 155° W. Fishing was also done in the late spring at ten secondary stations off the United States coast south to about 43° N.; in the late summer at seven stations just north of the three southernmost primary stations; and at four stations closer to the North American coast between Latitudes 48° - 49° N. (See Figure 1).

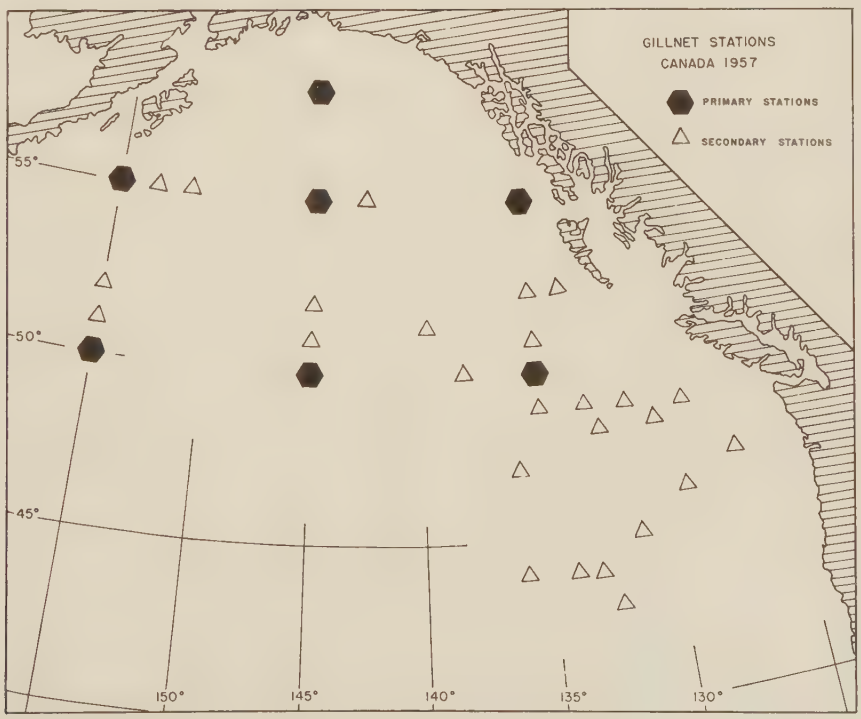

Fig. 1. Gillnet stations occupied by Canadian research vessels, 1957.

Gear. Nylon surface gill-nets of four different mesh sizes were used at all stations, each net or "shackle" being about 50 fathoms long and 20 feet deep. In 1957 a ratio of three shackles of 4½" mesh to one each of 2½", 3¼" and 5¼" was used. In 1956 three shackles of 5¼" mesh were used to one each of 2½", 3¼" and 4½". In 1957 the nets were "hung in" 57% on the cork lines; in 1956, 50%. In 1957 more shackles were set at a time than in 1956, the maximum number being 41 as compared with 24.

At certain stations occupied by the *Key West II*, sets were also made with a sunken gill-net. This consisted of 4½" mesh webbing hung in the same manner as the surface nets but having a depth of about 40 feet. It was suspended on drop lines from a surface rope which was supported by 21 inflated plastic buoys. The sunken net could be set to operate at depths of 20 to 60 feet, 40 to 80 feet or 60 to 100 feet. As originally made up and used, in June and July, the net was 200 fathoms long. It was subsequently damaged and reduced to a length of 50 fathoms.

SALMON CATCHES IN THE NORTHEAST PACIFIC BY CANADIAN RESEARCH VESSELS IN 1957.

Date	Position		Gill-Net			Surface	Species					
	Lat. (°N.)	Long. (°W.)	Type	No. of Shackles	Depth (ft.)	Temp. (°C.)	Sockeye	Pink	Chum	Coho	Chi-nook	Total
KEY WEST II												
May 13	47° 39′	126° 46′	Surface	21	0-20	11.3	—	—	—	2	1	3
14*	46° 12′	129° 20′	Surface	21	0-20	11.3	—	—	—	—	—	—
15	46° 12′	129° 20′	Surface	21	0-20	11.1	—	2	1	—	—	3
16	45° 00′	131° 15′	Surface	21	0-20	11.4	—	—	—	—	—	—
17	43° 54′	133° 13′	Surface	21	0-20	11.3	—	—	—	—	—	—
18	44° 04′	134° 40′	Surface	17	0-20	10.4	—	—	—	—	—	—
26	44° 56′	133° 38′	Surface	17	0-20	11.9	—	—	—	1	—	1
27	44° 53′	136° 10′	Surface	17	0-20	11.5	—	—	—	—	—	—
28	47° 00′	136° 07′	Surface	17	0-20	10.7	—	3	1	—	—	4
29	48° 00′	133° 12′	Surface	17	0-20	10.8	1	—	1	—	—	2
30	48° 12′	130° 19′	Surface	17	0-20	11.9	—	—	—	—	—	—
June 14	54° 53′	134° 22′	Surface	36	0-20	10.5	20	12	209	22	—	263
14	54° 53′	134° 22′	Sunken		20-60	10.5	1	—	4	—	—	5
15	55° 00′	135° 00′	Surface	36	0-20	10.5	38	23	353	25	—	439
29	55° 00′	145° 00′	Surface	36	0-20	10.5	11	9	80	17	1	118
29	55° 00′	145° 00′	Sunken		20-60	10.5	2	7	51	1	—	61
July 1	55° 00′	153° 17′	Surface	36	0-20	10.5	39	11	24	2	—	76
1	55° 00′	153° 17′	Sunken		20-60	10.5	9	8	33	—	—	50
2*	55° 00′	155° 00′	Sunken		40-80	10.0	15	1	5	—	—	21
3	55° 00′	155° 00′	Surface	36	0-20	10.0	125	9	64	—	—	198
3	55° 00′	155° 00′	Sunken		40-80	10.0	20	5	46	1	—	72
8	58° 00′	145° 00′	Surface	36	0-20	13.3	59	9	21	—	—	89
8	58° 00′	145° 00′	Sunken		20-60	13.3	10	7	22	6	—	45
9	58° 00′	145° 00′	Surface	36	0-20	13.0	18	19	71	12	—	120
9	58° 00′	145° 00′	Sunken		40-80	13.0	4	7	24	1	—	36
9*	58° 00′	145° 00′	Surface	4	0-20	13.0	—	1	1	—	—	2
9*	58° 00′	145° 00′	Sunken		40-80	13.0	—	1	1	—	—	2
10	58° 00′	145° 00′	Surface	35	0-20	13.0	37	24	36	8	—	105
10	58° 00′	145° 00′	Sunken		60-100	13.0	—	5	4	—	—	9
11*	55° 00′	145° 00′	Surface	6	0-20	12.5	—	—	1	—	—	1
11	55° 00′	145° 00′	Sunken		40-80	12.5	1	—	—	—	—	1
12	55° 00′	145° 00′	Surface	35	0-20	12.5	7	117	25	5	—	154
12	55° 00′	145° 00′	Sunken		40-80	12.5	2	9	—	—	—	11
31	55° 00′	135° 00′	Surface	41	0-20	15.2	17	45	3	2	—	67
31	55° 00′	135° 00′	Sunken		20-60	15.2	1	4	—	—	—	5
Aug. 1	55° 00′	135° 00′	Surface	41	0-20	15.2	15	56	3	3	—	77
1	55° 00′	135° 00′	Sunken		40-80	15.2	—	—	—	—	—	—
3	55° 07′	142° 40′	Surface	41	0-20	14.8	1	1	16	—	—	18
3	55° 07′	142° 40′	Sunken		20-60	14.8	—	—	—	—	—	—
8	55° 00′	135° 00′	Surface	41	0-20	14.0	2	5	—	—	—	7
8	55° 00′	135° 00′	Sunken		20-60	14.0	—	—	—	—	—	—
16	55° 00′	145° 00′	Surface	41	0-20	14.5	2	—	19	—	—	21
16	55° 00′	145° 00′	Sunken		20-60	14.5	—	—	2	—	—	2
18	55° 03′	151° 30′	Surface	38	0-20	15.0	11	—	71	—	—	82
18	55° 03′	151° 30′	Sunken		20-60	15.0	1	—	4	—	1	6
19	55° 00′	152° 56′	Surface	38	0-20	14.4	16	—	133	—	—	149
19	55° 00′	152° 56′	Sunken		20-60	14.4	—	—	2	—	—	2
22	58° 00′	145° 00′	Surface	38	0-20	15.5	2	1	128	—	—	131

* Day set. All others night sets.

Date	Position Lat. (°N.)	Position Long. (°W.)	Gill-Net Type	Gill-Net No. of Shackles	Gill-Net Depth (ft.)	Surface Temp. (°C.)	Species Sockeye	Pink	Chum	Coho	Chinook	Total
FORT ROSS												
May 19	55° 00′	135° 00′	Surface	20	0-20	8.2	3	—	5	—	—	8
20*	52° 30′	135° 00′	Surface	20	0-20	9.0	—	—	1	1	—	2
21	52° 30′	135° 00′	Surface	20	0-20	9.0	—	—	—	—	—	—
22*	55° 00′	135° 00′	Surface	20	0-20	9.0	1	—	1	—	—	2
23	55° 00′	135° 00′	Surface	20	0-20	8.2	2	—	58	2	—	62
June 8	50° 00′	135° 00′	Surface	35	0-20	13.8	30	18	46	115	—	209
9*	50° 00′	135° 00′	Surface	16	0-20	13.8	1	—	—	—	—	1
9	50° 00′	135° 00′	Surface	34	0-20	13.8	54	12	36	48	—	150
10	50° 00′	135° 00′	Surface	33	0-20	12.9	63	6	32	23	—	124
14	50° 00′	145° 00′	Surface	33	0-20	9.0	38	17	12	24	—	91
16	50° 00′	145° 00′	Surface	33	0-20		Species unidentified					
21	50° 00′	155° 00′	Surface	30	0-20	8.4	11	4	7	1	—	23
22*	50° 00′	155° 00′	Surface	30	0-20	8.8	—	—	—	—	—	—
22	50° 00′	155° 00′	Surface	30	0-20	8.3	4	3	6	2	1	16
23	50° 00′	155° 00′	Surface	30	0-20	9.0	66	13	11	8	1	99
24	50° 00′	155° 00′	Surface	30	0-20	8.3	2	—	—	2	—	4
28	50° 00′	145° 00′	Surface	26	0-20	9.7	7	10	14	2	—	33
30	50° 00′	145° 00′	Surface	26	0-20	10.0	8	19	34	17	—	78
July 2	50° 00′	138° 08′	Surface	26	0-20	11.0	36	1	2	—	—	39
3	50° 00′	135° 00′	Surface	26	0-20	11.7	20	12	13	—	—	45
20	51° 00′	135° 00′	Surface	35	0-20	14.4	120	2	—	—	—	122
21	51° 00′	135° 00′	Surface	35	0-20	13.4	7	—	—	—	—	7
24	51° 00′	145° 00′	Surface	35	0-20	12.1	—	—	—	—	—	—
26	51° 00′	145° 00′	Surface	35	0-20	11.5	—	—	—	—	—	—
28	51° 00′	155° 00′	Surface	35	0-20	11.0	2	—	6	—	—	8
29	52° 00′	155° 00′	Surface	35	0-20	11.0	2	—	3	—	—	5
30	52° 00′	155° 00′	Surface	35	0-20	11.0	22	—	2	—	—	24
31	52° 00′	155° 00′	Surface	35	0-20	11.5	9	—	16	—	—	25
Aug. 2	52° 00′	145° 00′	Surface	35	0-20	13.0	—	—	11	—	—	11
4	52° 00′	145° 00′	Surface	35	0-20	13.0	3	1	14	1	—	19
6	52° 00′	135° 00′	Surface	35	0-20	13.7	—	—	5	1	—	6
7	52° 00′	135° 00′	Surface	35	0-20	13.7	—	—	1	—	—	1
8	52° 00′	134° 00′	Surface	35	0-20	14.5	—	—	2	—	—	2
18	52° 08′	133° 25′	Surface	35	0-20	15.1	—	—	—	—	—	—
19	52° 30′	135° 00′	Surface	35	0-20	15.9	—	—	—	—	—	—
22	51° 00′	140° 00′	Surface	35	0-20	14.4	—	—	—	—	—	—
25	49° 01′	134° 24′	Surface	35	0-20	15.4	—	—	—	—	—	—
26	48° 55′	132° 42′	Surface	35	0-20	15.8	—	—	—	—	—	—
27	48° 50′	131° 06′	Surface	35	0-20	15.7	—	—	—	—	—	—
28	48° 40′	129° 32′	Surface	35	0-20	16.7	—	—	—	—	—	—
Totals							998	519	1,797	355	5	3,674
							Species unidentified (June 16)					47
												3,721

* Day set. All others night sets.

Salmon catches and distribution. Preliminary examination of the surface gill-net catches (see accompanying table) suggests that, in general, catches of pink and chum salmon were relatively great in the northern part of the Gulf of Alaska, coho in the eastern part and sockeye south of the Alaskan Peninsula. As in 1956 the southern limit of the catches moved northward as the summer advanced. Catches were generally smaller in the latter part of the summer, apparently reflecting the migration of mature salmon from the high seas towards the spawning grounds. In the total catch for the season, sockeye and chums showed a percentage increase over 1956, while pinks and cohos formed a relatively smaller percentage of the catch. The comparison is shown by the following figures:

		Sockeye	*Pink*	*Chum*	*Coho*
1956	%	21	27	37	15
1957	%	27	14	49	10

The catches of the sunken gill-net were sometimes larger, per unit area of net, than the catches of surface nets of the same mesh, fished at the same time. Operation of this net was only practicable in good weather. Sockeye were mainly caught close to the surface, but pinks and chums were on some occasions more numerous in the sunken net. Both these species

were taken down to the deepest level (60 to 100 feet) at which fishing was conducted. The data obtained are too limited to justify firm conclusions, but they raise the question of how representative the surface catches are. Further investigation of the vertical distribution of Pacific salmon seems desirable.

Associated studies. Oceanographic observations and plankton collections were made in conjunction with the high-seas fishing in 1957 as in 1956. In the Gulf of Alaska, surface waters were warmer and plankton sparser in 1957 than in 1956.

2. SKELETAL ANATOMY OF PACIFIC SALMON

In 1957 the descriptions of the osteology of the five principal species of Pacific salmon of the genus *Oncorhynchus* at various stages of their life history have progressed far enough to make it possible to distinguish between the changes associated with the approach of maturity and the more stable differences which might be used to distinguish stocks of different origins. The search for such differences is still in progress and offers limited promise.

3. STUDY OF SALMON PARASITES TO DISTINGUISH STOCKS

A. Results of examination of 1956 samples of sockeye and pink salmon

From 1956 collections 1,391 sockeye (400 downstream migrants and 991 adults or high-seas specimens) and 777 pinks (668 adults and 109 juveniles) were examined. As in 1955 collections, a sample of 25 fish was examined from each locality, where possible. Pink fry were not examined because the 1955 samples had indicated that they were free or almost free of parasites.

The sockeye smolts were taken from 16 North American localities from the Columbia River to Bristol Bay. Sockeye adults were examined from 21 localities along the North American coast and the Aleutians and from 35 localities on the high seas. The latter were spaced approximately at intervals of 5 degrees of longitude across the North Pacific from 140° W. to the Sea of Okhotsk and between 165° W. and 180° in the Bering Sea. Most adult coastal and high-seas sockeye were caught in late June, July and August with a few in early June and early September.

Juvenile pink salmon were taken in the vicinity of the outflow of the Skeena River, British Columbia, in July and August. Adult pinks came from 15 localities along the North American coast and the Aleutians, one in Hokkaido, Japan, and 29 on the high seas distributed as in the case of sockeye, but with less complete coverage. Lack of adequate samples between 160° W. and 180° is particularly noticeable. In the Bering Sea, samples were taken only at 170° W. and 180°. Most of the high-seas samples were taken in June and July, with some in May and August. The coastal samples were taken mainly in July and August with some in September and early October.

About 50 species of parasites were found, about one-third of which were of freshwater origin. In sockeye salmon 6 species (2 from fresh water), and in pinks 3 species, appear to be significant in differentiating between Asiatic and North American stocks of salmon. It is well to be reminded that the data apply only to the distribution of various stocks when the samples were taken and may not reflect their distribution at other times of the year or in other years.

(i) Sockeye salmon

(a) **Parasites acquired in the sea.** Three of the parasites which salmon acquire in the sea *(Hemiurus, Tubulovesicula* and *Echinorhynchus)* were more or less restricted in high-seas samples either to the eastern or to the western Pacific; a fourth *(Anisakis),* although present in almost every fish, had a much higher intensity in western than in eastern samples. The parasite characteristics of eastern high-seas samples are similar to those of North American coastal samples, and it appears that the continental origin of sockeye stocks may be traced by use of the parasites discussed below.

Hemiurus levinseni was present in the 5 samples from 171° E. to the Sea of Okhotsk. It was absent from 6 Bering Sea samples east of 180°, from 8 Pacific samples between 172° E. and 155° W., and from a sample at 140° W. It was present but rare at 145° W. and 150° W. In coastal sockeyes, *Hemiurus* was encountered in the adjacent areas of Petersburg, southeast Alaska, and the Skeena River, British Columbia, and a single specimen in one fish at Kuskokwim, western Alaska. In relating the distribution of *Hemiurus* in high-seas sockeyes to that in coastal sockeyes, it seems that the presence of *Hemiurus* at 145° W. and 150° W. indicates origin of at least some of these fish from the Petersburg-Skeena area. Absence of this trematode at 140° W. can be related to its absence in the more southerly North American coastal samples. The complete lack of *Hemiurus* in all high-seas samples between 172° E. and 155° W. and in the eastern Bering Sea parallels its absence in all Alaskan areas north of Petersburg, except for the single occurrence at Kuskokwim. The consistent presence of *Hemiurus* between 171° E. and the Okhotsk Sea probably indicates the Asiatic origin of these samples.

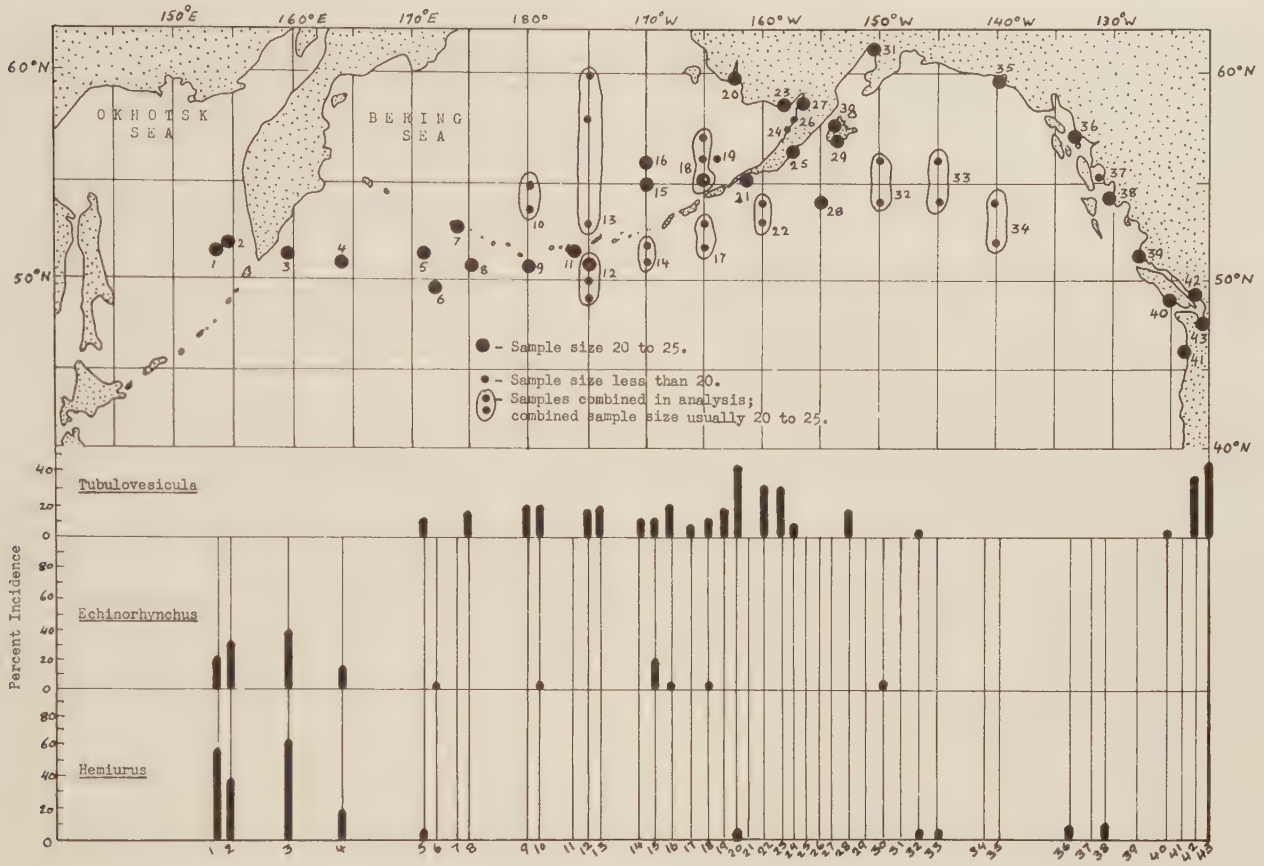

Fig. 2. Distribution of sockeye salmon samples examined for parasites from 1956 collections, and incidence, in percent, of *Hemiurus*, *Echinorhynchus* and *Tubulovesicula* in these samples.

Tubulovesicula lindbergi was well represented in all high-seas samples from 150° W. to 175° E. and at 171° E., but lacking at 172° E. and from 164°E. to the Okhotsk Sea. It was present in all Bering Sea samples from 180° to 165° W. In coastal North American samples it was present in 3 Bristol Bay or western Alaskan areas and in 3 southerly areas in British Columbia and Puget Sound. Although many of the North American coastal samples had no *Tubulovesicula* in 1956, the samples from some of these areas showed it in 1955. Its presence in the eastern Bering Sea samples and in high-seas areas, south of the Aleutians, between 175° E. and 150° W., and at 171°E., probably relates many of these fish to North American coastal samples. The sample at 172° E. is related to those taken between 164° E. and the Okhotsk Sea, by the absence of *Tubulovesicula*.

The *Tubulovesicula* taken in the southerly coastal areas of North America were immature, whereas they were mature in all other coastal areas and high-seas samples. It appears that *Tubulovesicula* in southern North American coastal areas is the result of infection upon reentry into coastal waters and that fish from these areas may not be related to those infected with *Tubulovesicula* on the high seas. It is probably significant that at 140° W. and 145° W., *Tubulovesicula* was not found in the samples and that these fish seem to represent stocks from southern North American coastal areas.

At 171° E. where both *Hemiurus* and *Tubulovesicula* were found, they occurred in different fish in the sample, which is compatible with the interpretation that in this area *Hemiurus* indicates Asiatic origin and *Tubulovesicula* indicates North American origin.

Echinorhynchus gadi was noted in 5 of the 6 samples from 172° E. to the Okhotsk Sea. It was absent in high-seas samples south of the Aleutians at 171° E. and from 175° E. to 140° W. In the Bering Sea it occurred in 4 of 6 samples between 180° and 165° W., but not in the sample at 175° W. nor in one of the 2 samples at 165° W. In all North American coastal samples it was seen only in one fish from Kodiak. Its absence from 175° E. to 140° W. south of the Aleutians suggests that these fish are of North American origin. From 172° E. to the Okhotsk Sea, the occurrence of *Echinorhynchus*, except at 171° E., suggests a predomin-

ance of Asiatic stocks. In the Bering Sea its presence from 165° W. to 180° implies that some of these fish are of Asiatic origin. They might be fish of North American origin which had been in Asian waters, but *Echinorhynchus* and *Tubulovesicula* (which probably indicates North American origin) never occurred in the same individual fish (although in the same sample).

The distribution and incidence of *Hemiurus*, *Tubulovesicula* and *Echinorhynchus* in sockeyes is shown graphically in Figure 2.

Anisakis larvae are known to accumulate as the fish grow older. Therefore any comparison of the levels of infection of various stocks must take into account the number of years the fish have spent at sea. Although almost 100% of the samples were infected with this parasite, there were pronounced differences in the level of infection between samples taken from 171° E. to the Sea of Okhotsk and almost all those taken east of 171°E., except for the Kuskokwim, Alaska, sample. The average level of infection of fish with 2+ and 3+ years at sea in the western group of samples was greater than 21 and 28, respectively, whereas for samples taken east of 171° E. the corresponding average numbers of *Anisakis* per fish were less than 21 and 28, and frequently only half of these values. Many more individual sockeye in the samples between 171° E. and the Okhotsk Sea than in the more easterly samples had more than 20 or 25 *Anisakis* in the 2+ and 3+ groups, respectively. It seems that high levels of *Anisakis* infection are generally indicative of Asiatic stocks.

(b) **Parasites acquired in fresh water.** *Triaenophorus crassus* larvae were found only in adults and smolts of the Wood River - Nushagak River systems and less commonly at Naknek River, both in Bristol Bay. Smolts from Asiatic areas were not available, but the literature does not record *T. crassus* as a parasite of sockeyes in Kamchatka, where studies on parasites of salmon have been carried out. *Triaenophorus* matures only in pike and hence can be present in sockeyes only if sockeye and pike occur in the same waters. *Triaenophorus* was found occasionally in 4 of the 8 high-seas samples between 150° W. and 175° E., south of the Aleutians. On the basis of our present knowledge it is concluded that *Triaenophorus*-infected sockeyes on the high seas are of Bristol Bay origin.

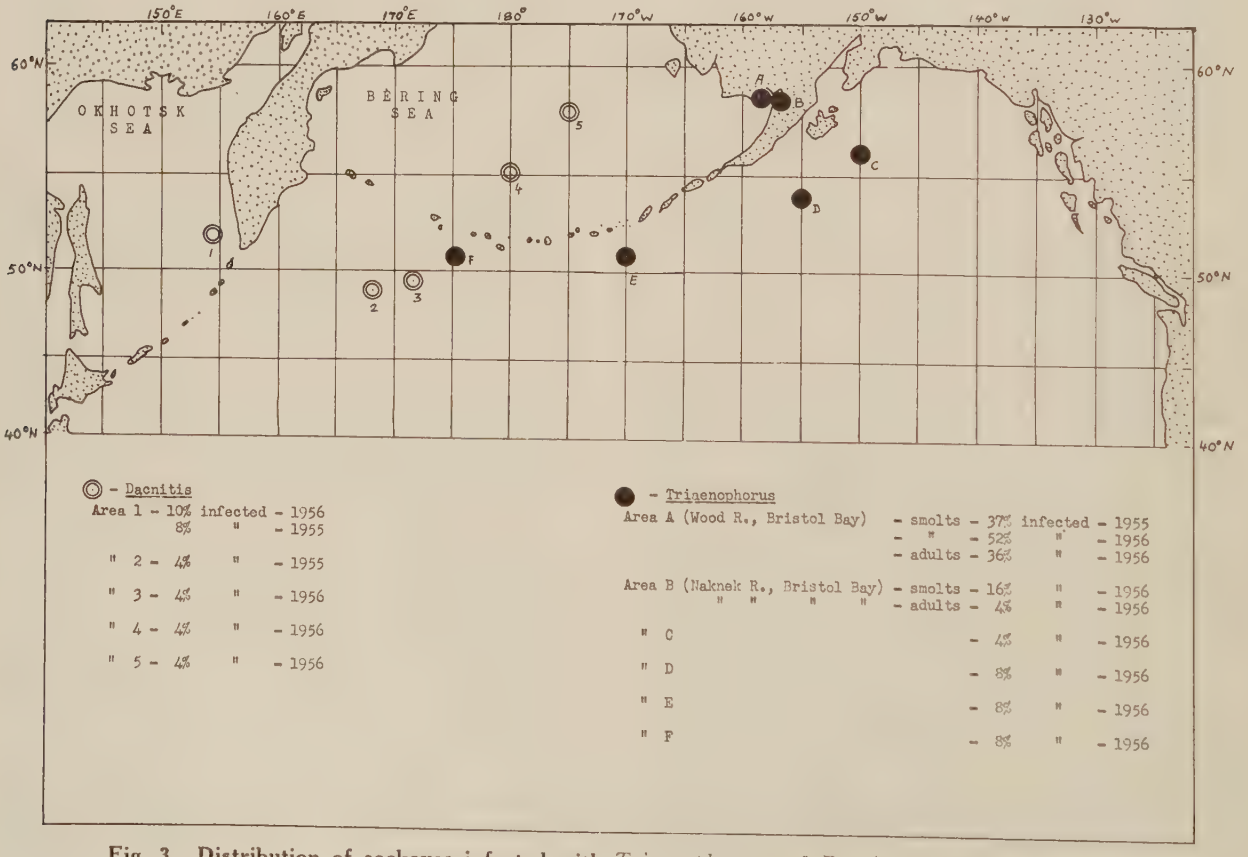

Fig. 3. Distribution of sockeyes infected with *Triaenophorus* and *Dacnitis* in 1955 and 1956 samples.

Dacnitis truttae was found occasionally in 3 of 6 samples from the Okhotsk Sea to 172° E., south of the Aleutians, and at 180° and 175° W. in the Bering Sea. The literature records it is a parasite of sockeyes in the Kamchatka Peninsula. All high-seas samples east of 172° E., south of the Aleutians and east of 170° W. in the Bering Sea, and all North American samples of adults and of smolts were free of this parasite. On the basis of present knowledge, it is concluded that *D. truttae* in high-seas sockeyes is indicative of their Asiatic origin.

Figure 3 shows the distribution and records the incidence of these two parasites in 1955 and 1956 samples of sockeyes.

(c) **Summary.** On the basis of the occurrence of three parasites acquired in the sea (*Hemiurus, Echinorhynchus* and *Tubulovesicula*), and of the intensity of infection by *Anisakis*, samples taken on the high seas east of 175° E., south of the Aleutians, showed a marked relationship to North American coastal samples. Samples from west of 171° E. appeared to be different from those taken in North American coastal waters and from those taken east of 175° E., and probably represent Asiatic stocks. Two samples, at 171° E. and 172° E., on the basis of the same parasites contain fish relating them to samples taken both east and west of these meridians. In the Bering Sea, on the other hand, *Echinorhynchus*, as well as *Tubulovesicula*, were present in samples between 165° W. and 180°. These two parasites never occurred in the same fish and if, as seems to be the case, *Echinorhynchus* in sockeyes indicates Asiatic origin and *Tubulovesicula* North American origin, then the Bering Sea samples represented fish from both continents. Furthermore, two parasites acquired in fresh water support the above implications. *Triaenophorus*, indicative of certain Bristol Bay stocks, was found occasionally in samples as far west as 175° E. and *Dacnitis*, indicative of Asian stocks, was found in samples as far east as 172° E., south of the Aleutians, and at 180° and 175° W. in the Bering Sea.

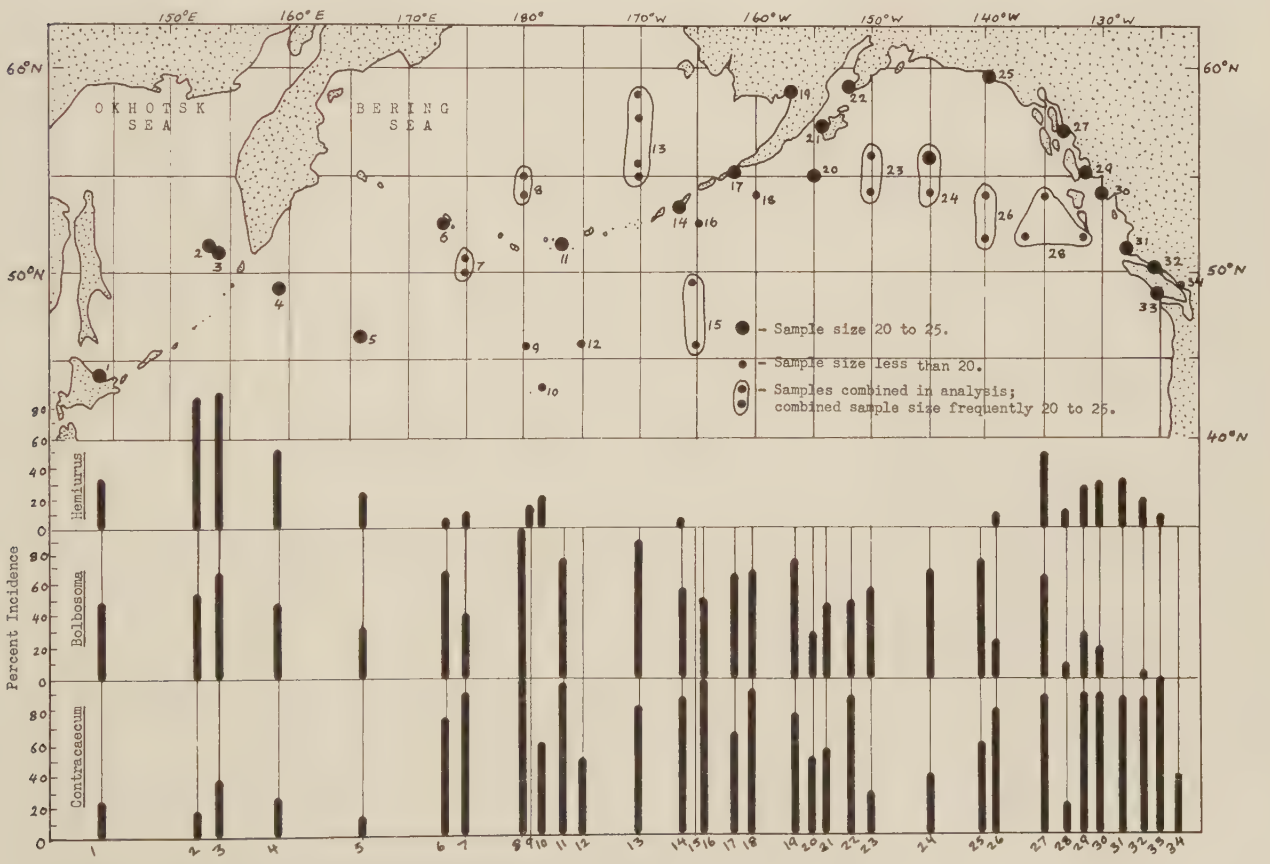

Fig. 4. Distribution of pink salmon samples examined for parasites from 1956 collections, and incidence, in percent, of *Hemiurus, Bolbosoma* and *Contracaecum* in these samples.

(ii) **Pink salmon**

No one species of parasite was found whose distribution permitted the division of high-seas samples into two groups, an eastern and a western, as was indicated for sockeyes. Nor was there a regular gradation in the incidence of certain parasites in an east-west or west-east direction, as appeared to be the case in the less adequate 1955 samples. Nevertheless there were certain marked discontinuities in the distribution or abundance of certain parasites which seem to indicate three main groups of high-seas samples which can be related to coastal samples from three regions. The parasites which best illustrate this division are *Hemiurus, Bolbosoma* and *Contracaecum.* The distribution and incidence of infection of pink salmon by these parasites is shown graphically in Figure 4.

Hemiurus levinseni occurred in high-seas samples from 140° W. to 132° W. and from the Okhotsk Sea to 178° W. From 175° W. to 145° W. and in the Bering Sea samples at 170° W. and 180° it was absent. *Hemiurus* was well represented in coastal samples from southeast Alaska, southward and from Hokkaido. It was also observed in one fish each at Unalaska and Attu. It was absent from central and western Alaska.

Bolbosoma was encountered in less than 25% of the fish in samples from 140° W. to 132° W. and in coastal samples south of Ketchikan in southeast Alaska. In central and western Alaska the incidence was about 50% to 75% in each sample, which coincides generally with that in high-seas samples from 145° W. to 165° W. and in the Bering Sea. At Hokkaido and from 175° E to the Okhotsk Sea the incidence was approximately 50%.

A high incidence of *Contracaecum,* between 50% and 100%, characterized samples taken in North American coastal waters and generally in high-seas samples east of 175° E. and in the Bering Sea. The incidence of *Contracaecum* in samples from west of 175° E. on the high seas and at Hokkaido was about 25%. Not only was the incidence higher in eastern samples, but the intensity of the infection was markedly greater.

On the basis of these three parasites the following groups of samples have been recognized:

(1) **Asiatic group.** This group is characterized by the prominence of *Hemiurus* and *Bolbosoma.* It includes the samples from Hokkaido and from the Sea of Okhotsk to 175° E. at approximately 50° N., intergrading between 170° E. and 175° E. with group (3).

(2) **Southern North American group.** This group is characterized by the prominence of *Contracaecum* and *Hemiurus,* with low incidence or absence of *Bolbosoma.* It includes coastal samples from southeast Alaska southward and high-seas samples west to 140° W. Another parasite, *Parahemiurus,* also is restricted to this group. From south to northwest in this group there is an increase in *Bolbosoma* incidence, providing a transition to group (3).

(3) **Central and western Alaska group.** The dominant features of this large group of samples are the almost complete absence of *Hemiurus* and the prominence of *Contracaecum* and *Bolbosoma.* It includes coastal samples from central and western Alaska and high-seas samples between 145° W. and 165° W. at latitudes north of 50° N. The samples at 175° E. and at Attu show the high *Contracaecum* of this group, but also the *Hemiurus* of group (1). There thus appears to be an overlap with the Asiatic group between 170° E. and 175° E.

A small group of samples taken between 165° W. and 180° at latitudes south of 50° N. (principally between 42° N. and 46° N.) did not possess the combinations of characteristics of any of the above 3 groups, mainly because of the complete lack of *Bolbosoma.* Two samples taken between 178° W. and 180° showed the *Hemiurus* character of the Asiatic group, the sample at 178° W. showing also the high *Contracaecum,* similar to the North American group. At 175° W. the high *Contracaecum* (50%) and lack of *Hemiurus* showed possible relationship with North American groups. A sample at 165° W. was even more difficult to place in any of the 3 groups, because of a general lack of parasites, but the high incidence of another trematode, *Bucephaloides,* tends to show relationships with North American samples.

B. **Comparison with 1955 samples**

The number of samples of adult or high-seas sockeyes and pinks examined from 1956 catches was more than twice the number examined from 1955 catches. This was due largely to a much more extensive distribution of high-seas samples, but also a greater coverage of coastal areas. Sockeye smolts from more localities were also examined in 1956.

There is a reasonably good similarity in incidence of parasites and degree of infection in the localities from which fish were examined in both years. Certain rare parasites did not occur in both years, other parasites showed a lower incidence or intensity in 1956, and still others seemed to occur more frequently. No attempt has been made, however, to test for statistical significance of these differences. The parasites acquired in the sea which apparently show continental origins

of sockeyes were very similar in the two years. The role of *Lecithaster* in identifying eastern stocks was considered a possibility in 1955 samples but it has since been noted that *Lecithaster* probably reflects differences between coastal and high-seas samples rather than east-west differences. The significance of *Anisakis* was not appreciated in the 1955 samples, because the sockeyes had not been aged. The significance of parasites acquired in fresh water, such as *Triaenophorus* and *Dacnitis*,

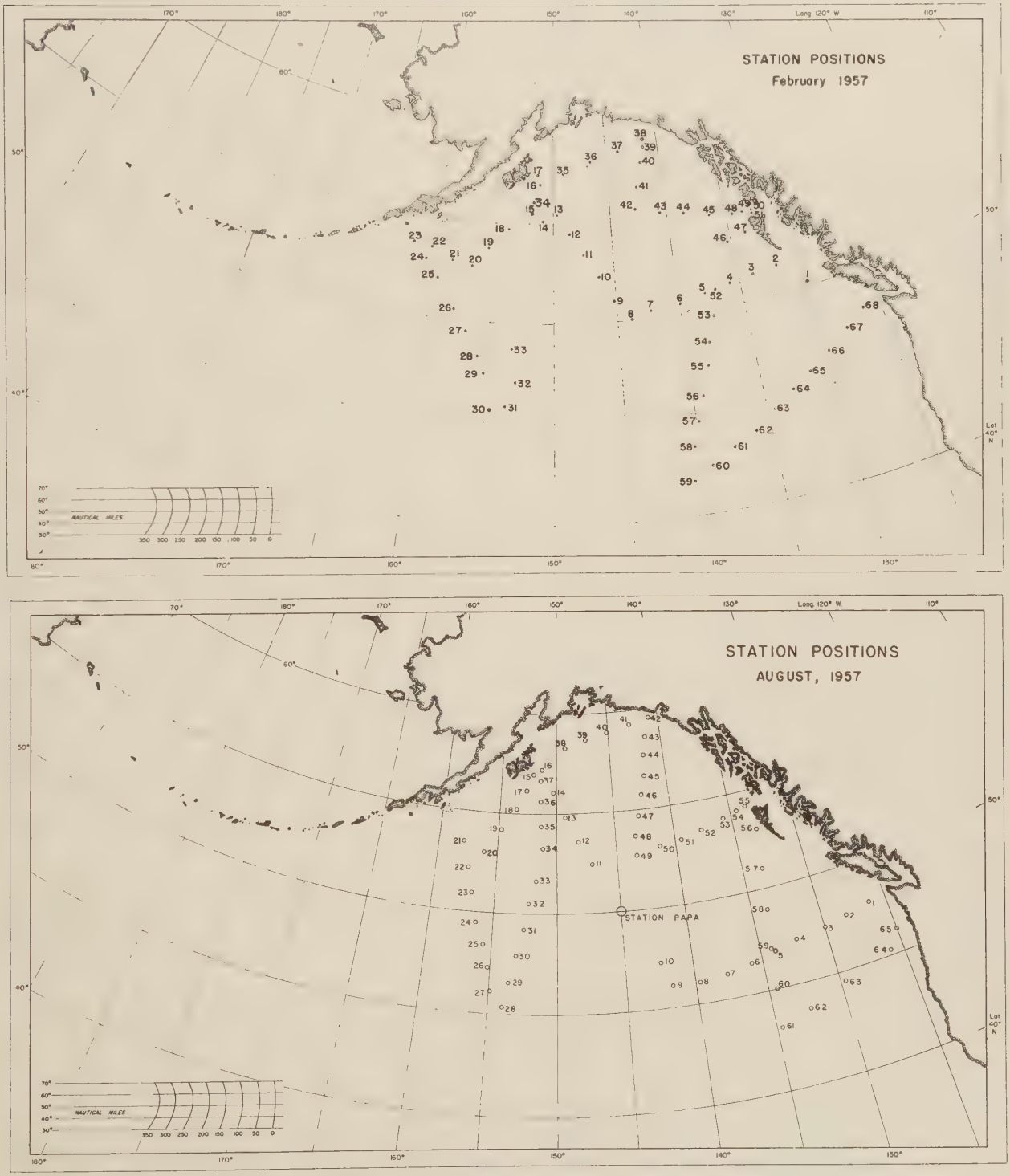

Fig. 5. Oceanographic stations occupied by Canadian vessels in February and August, 1957.

in identifying the continental origin of individual fish, was not fully appreciated in 1955 because of the paucity of high-seas samples.

In the summary prepared last year, on the basis of 1955 samples, 8 parasites were selected as possibly significant in the identification of two groups of high-seas pink salmon samples relating to their continental origin. These were *Bolbosoma, Contracaecum, Echinorhynchus, Bucephaloides, Tubulovesicula, Lecithaster, Derogenes* and *Eubothrium. Bolbosoma* and *Contracaecum* were considered of prime importance, as again noted this year, although 3 groups, rather than 2 groups of samples, are recognized. In addition, *Hemiurus* is considered of importance in 1956 samples, and basically showed the same type of distribution in 1955 samples, but was not then considered in the distinction of stocks because of the prime concern with searching for two groups of stocks, rather than three, as conceived at present. *Lecithaster, Derogenes,* and *Eubothrium,* of doubtful value in 1955 samples, seem to show differences which reflect coastal in contrast to high-seas distribution, rather than east-west differences. *Bucephaloides, Tubulovesicula* and *Echinorhynchus* may still be of value, but their occurrence does not at present give a sufficiently clear picture to delimit groups of pink salmon stocks.

C. Examination of 1957 samples

Examination of samples collected in 1957 is now in progress. Samples are available from essentially the same localities as in 1956 but with more adequate samples of pinks from the high seas. Furthermore, at least two, and possibly three samples, taken at intervals of two weeks to one month from the same high-seas stations, are available in many instances. Examination of these samples should yield information on the constancy or variability of parasitism in samples taken at the same locality through the months of June to August.

4. OCEANOGRAPHY

Since the last summary report (September, 1956) two more surveys of the Gulf of Alaska and the adjacent ocean have been completed (Figure 5). The first, from January 22 to March 4, was the first truly winter survey of the sub-Arctic regions of the North Pacific. The second was made from July 22 to August 30, 1957, and covered the same area with a similar cruise plan. This was the fourth summer survey in this area. The previous surveys were: August, 1954, by the University of Washington; August, 1955, by the University of Washington and the Pacific Oceanographic Group (P.O.G.) of the Fisheries Research Board of Canada in the Nor-Pac project; and August, 1956, by P.O.G. Data records of the 1955, 1956 and 1957 surveys have been distributed, and it is expected that data records of the 1957 winter and summer surveys will be available before the 1957 meeting of the Commission.

Analysis of the data is proceeding. A progress report, similar to, but more advanced than, that made to the Committee on Biology and Research in March, 1957, is in preparation. In the meantime it is possible to summarize the observational work of the past year and comment on the more important features.

Temperature. Figure 6 shows the temperature distribution in the area during February, 1957. The temperature decreased from south to north and the isotherms sloped northeastward. The surveys only reached the northern fringes of the Polar Front. It is evident, however, that the warm southern water occurred farther north near the American continent than in mid-ocean. The coldest water was found in an elongated area a short distance south of Kodiak and the Shumigan Islands. This cold centre has the same location as the coldest water found in the summer surveys.

The cross-sections show that in the eastern part of the area (Sections A and B) the water was warmest at the surface (upper 10 to 20 meters) and became colder with depth to about 100 meters. Below this the temperature increased about one degree to 200 meters. Below 200 meters the temperature again decreased slightly with depth to 1,000 meters. Thus there is an upper zone separated from a deep zone by a positive thermocline. The temperature inversion in the positive thermocline is stable because it coincides with the halocline. At the western limit of the survey (Section C), the positive thermocline was only in evidence near the Alaska Peninsula. Farther offshore the waters were isothermal from the surface to about 200 meters depth. Below this the temperature decreased to 1,000 meters depth.

Figure 7 shows the grand monthly mean of the surface sea-water temperature at ocean weather station "PAPA" (50° N., 145° W.) from 1950 through 1956 and, for comparison, the monthly mean temperatures through the past winter (1957). It is evident that the surface waters were warmer than average, both at the surface and at 70 meters depth.

The temperature distribution observed in August, 1957, is shown in Figure 8. As usual the waters were warmest at the southern limits of the area, and coldest in the region just south of Kodiak and the Shumigan Islands. This cold centre was rather smaller, warmer, and farther

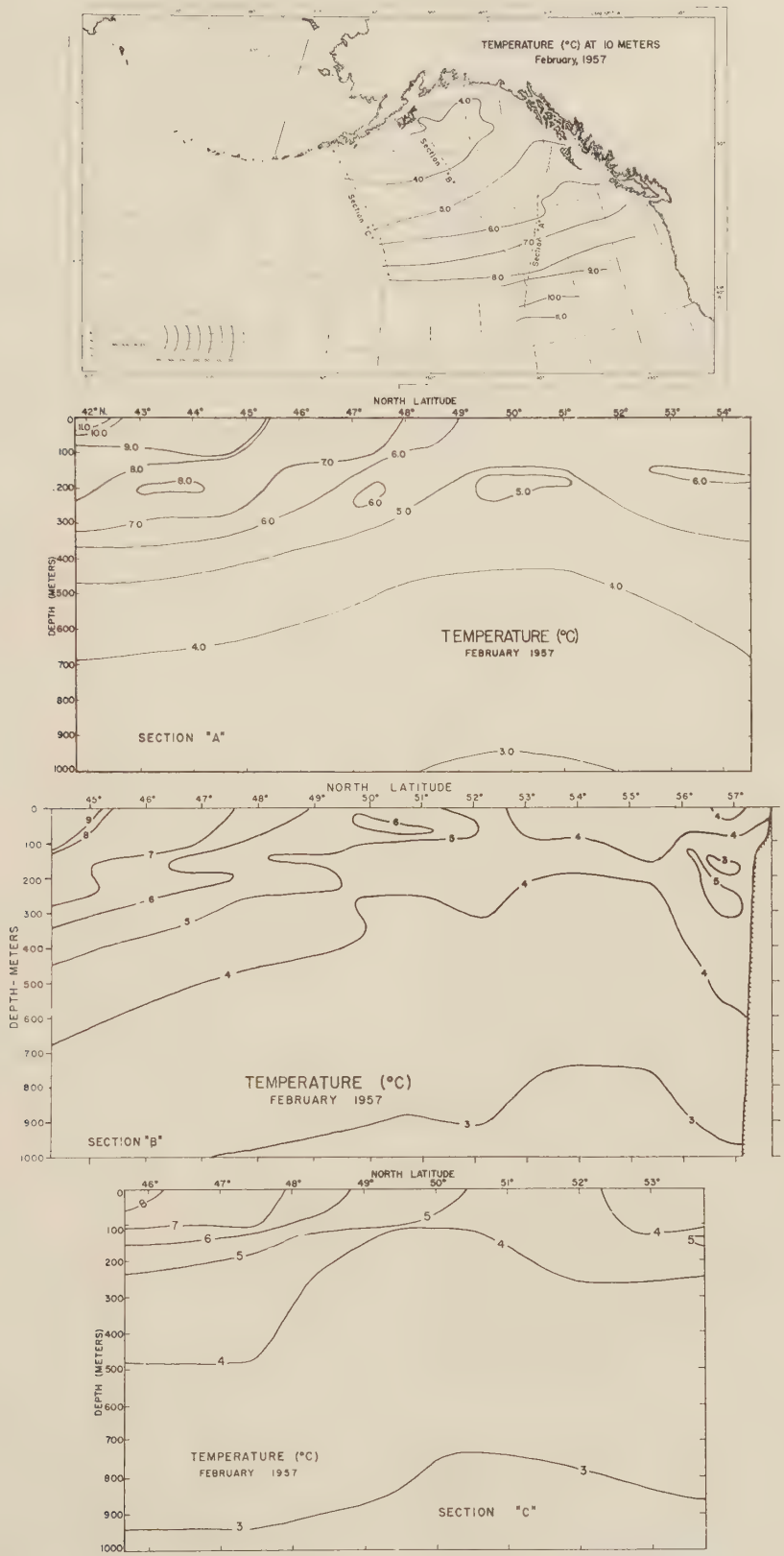

Fig. 6. Temperatures in the eastern North Pacific in February, 1957.

westward than in previous summers. The isotherms entered the area from the west and curved around the cold centre so that there was a warm area between station "PAPA" and the Canadian coast. A small body of warm surface water was isolated in the northeast part of the area near the Alaskan coast. This has not been observed in previous surveys. Further study of the data will be required to determine its origin and cause.

The cross-sections show that the warm upper waters extended to a thermocline between 30 and 100 meters depth as usual. Below this the waters became colder with depth. There was an evident dome of cold water in the deep zone, immediately below the cold centre off Kodiak and the Shumigan Islands. This dome was separated from the near surface waters by a temperature inversion in the halocline. This structure has been observed regularly in the summer surveys and is evidence that the cold dome and the deep waters are separated. In previous summer surveys temperature inversions in the halocline have been regularly observed in the eastern part of the area, between station "PAPA" and the Canadian coast, but this structure was not common in August, 1957.

Salinity. The winter and summer salinity data are summarized in Figures 9 and 10. Here it is evident that the distribution and structure were similar in the two seasons. There was an upper zone of salinity less than 32.8‰ extending to about 100 meters depth. From 100 to 200 meters depth there was a halocline in which the salinity increased one part per thousand to 33.8‰. Below this the salinity increased to about 34.4‰ at 1,000 meters. The density gradient inherent in the halocline makes the temperature inversions possible and stable in this zone.

The surface salinity was greatest at the southern limit of the area, became less towards Latitude 50° N. and towards the coast, all around the region. There was a small secondary maximum, greater than 32.8‰ in the vicinity of the cold centre near Kodiak and the Shumigan Islands.

The sections show that the halocline was continuous and at nearly the same depth over the whole area. It was shown in the NorPac (1955) data that this upper zone of low salinity extended over the sub-Arctic region where precipitation exceeds evaporation. It vanishes to the south at the "Polar Front" where the halocline comes to the surface. The surveys in 1957 did not reach far enough south to determine the limit of this structure. They approached it, however, as indicated by the increasing surface salinity at the southern boundary.

The secondary maximum at the cold centre is shown to be an upper zone phenomenon. The halocline (33.0 to 33.8‰) is continuous through this region. This is positive evidence of the separation of the upper and deep zones.

In the deep zone the salinity increased only slightly with depth, and there was little or no significant variation over the region or from winter to summer.

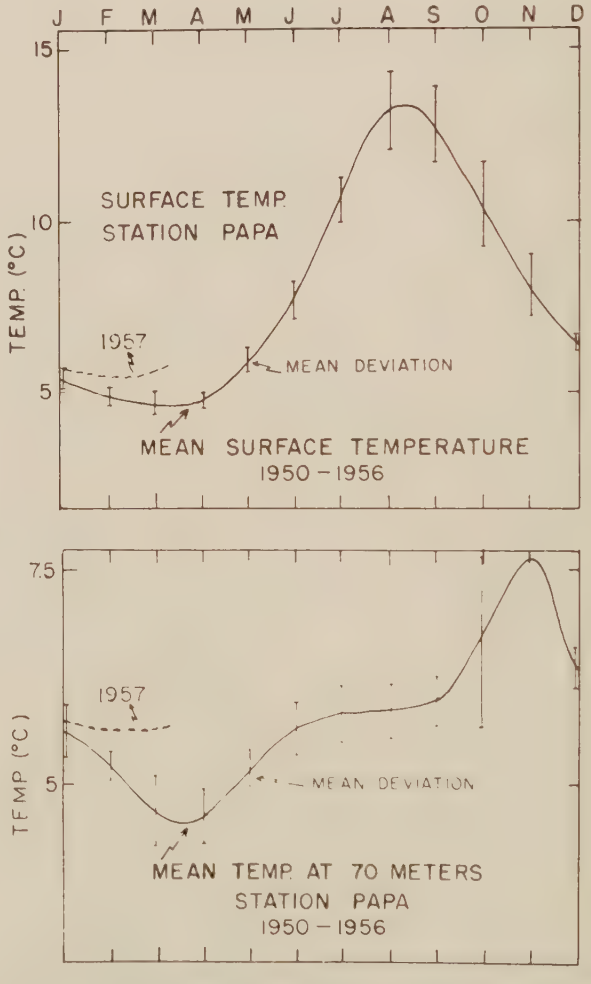

Fig. 7. Monthly mean temperatures, 1950 to 1956, (solid line) and temperatures in early 1957 (broken line) at weather station "PAPA" (50°N., 145°W.)

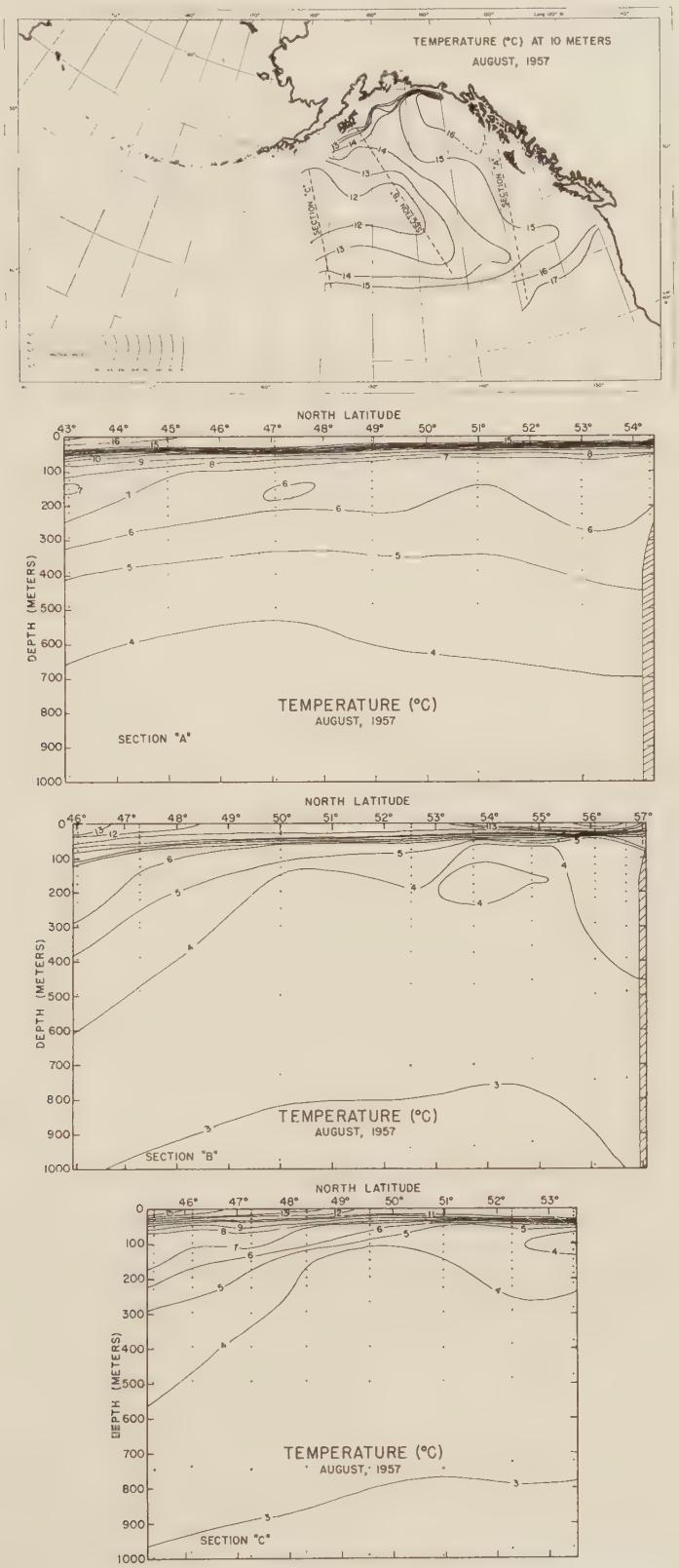

Fig. 8. Temperatures in the eastern North Pacific in August, 1957.

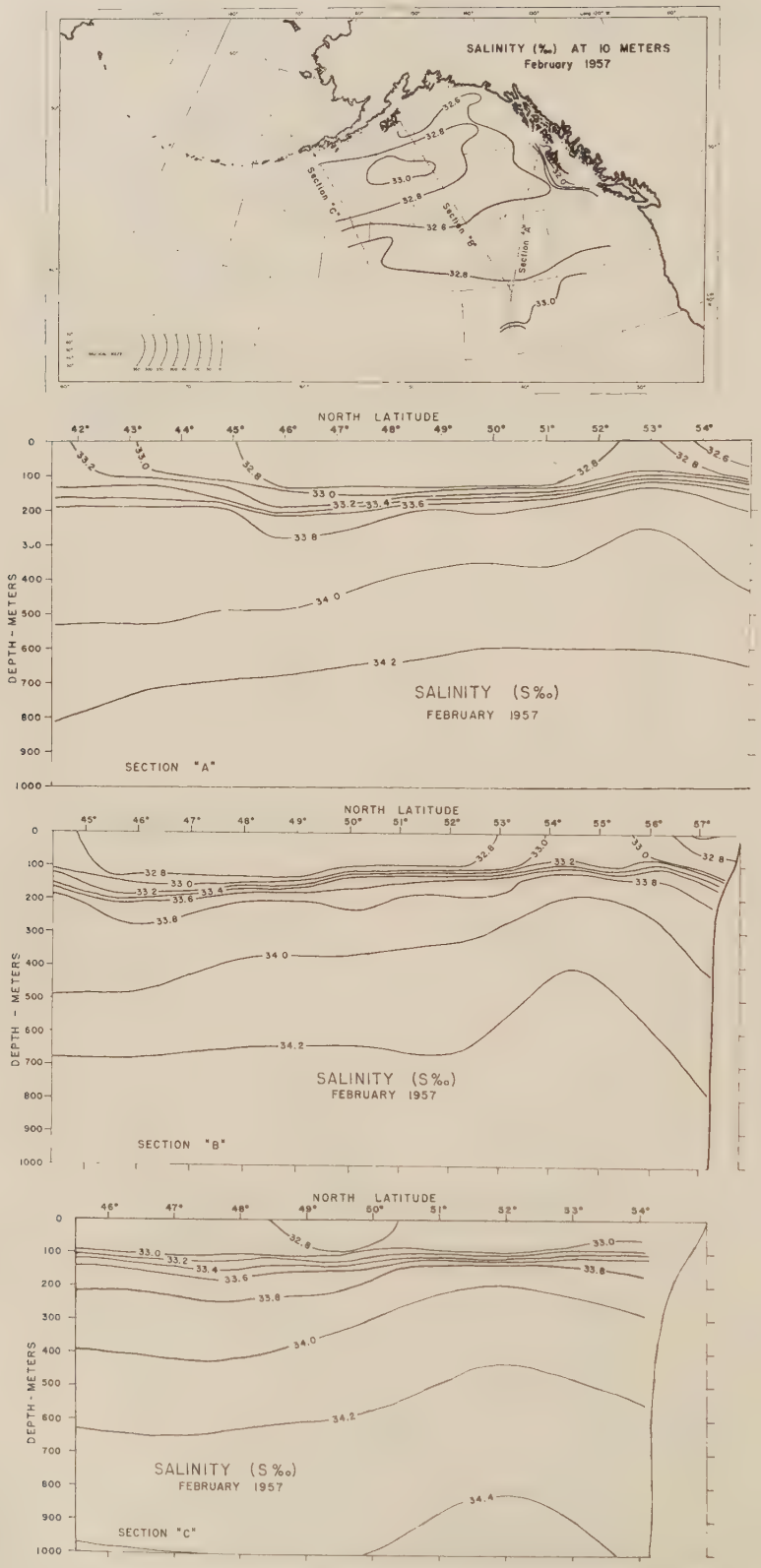

Fig. 9. Salinities in the eastern North Pacific in February, 1957.

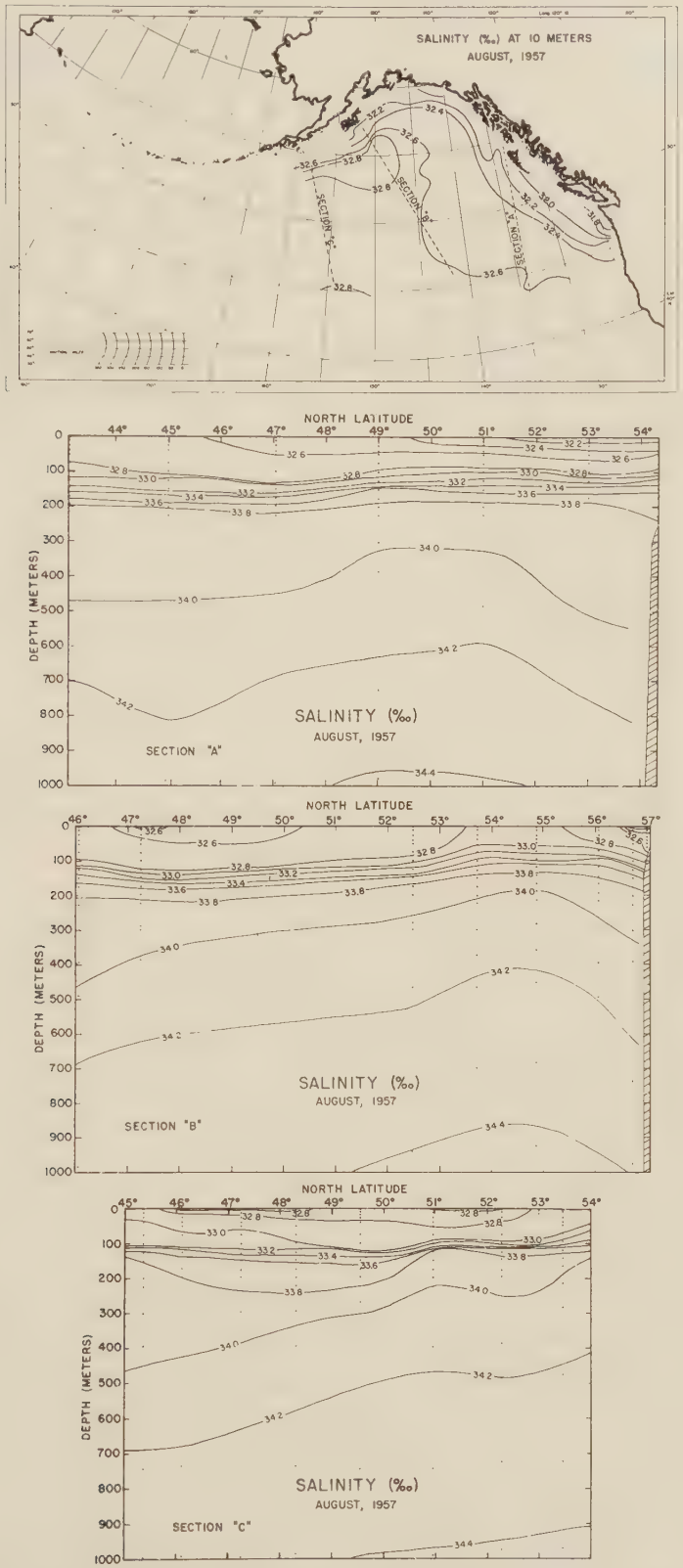

Fig. 10. Salinities in the eastern North Pacific in August, 1957.

Currents. The dynamic computations on the August, 1957, cruise have not yet been completed. They will be shown in a later report. The computations have, however, been made for the winter data (February, 1957) and are shown in Figure 11. It shows that the northern side of the West Wind Drift Current enters the area from the southwest. Most of this water circulates anti-clockwise around the cold centre in the Gulf of Alaska. The current becomes narrower and more intense in the north and along the Alaskan Peninsula. Water also enters along the southern limit of the area, moves towards the American coast and then turns southward. This is evidently the edge of the Kuroshio extension which just intrudes the area before turning south to join the California Current. The approaches to the Canadian coast constitute the region of divergence between the northern and southern (sub-Arctic and sub-Tropic) limits of the West Wind Drift.

Chemical properties and plankton. The concentration of dissolved oxygen is between 80% and 100% of saturation throughout the upper zone. It is highest in the cold centre and lowest near the coast and along the southern side of the region. It decreases markedly in the halocline, and continues to decrease with depth in the deep zone. There is a dome of very low oxygen concentration coincident with the dome of deep cold water.

The concentrations of inorganic phosphate and silicitate are high in the upper zone waters, increasing from the limits of the area toward the cold centre. In the deep zone there is a dome of extraordinarily high concentration of these constituents, coincident with the dome of deep cold water.

The concentrations of dissolved nitrite are low and are frequently zero in both upper and deep zones. There is, however, a thin layer of very high concentration coincident with the lower part of the thermocline over the whole area.

In the upper 150 meters of depth there was about 20 times as much plankton in summer as in winter. This seasonal difference decreased with depth to the limit of sampling at 1,000 meters. There was more plankton in the coastal approaches than in mid-ocean.

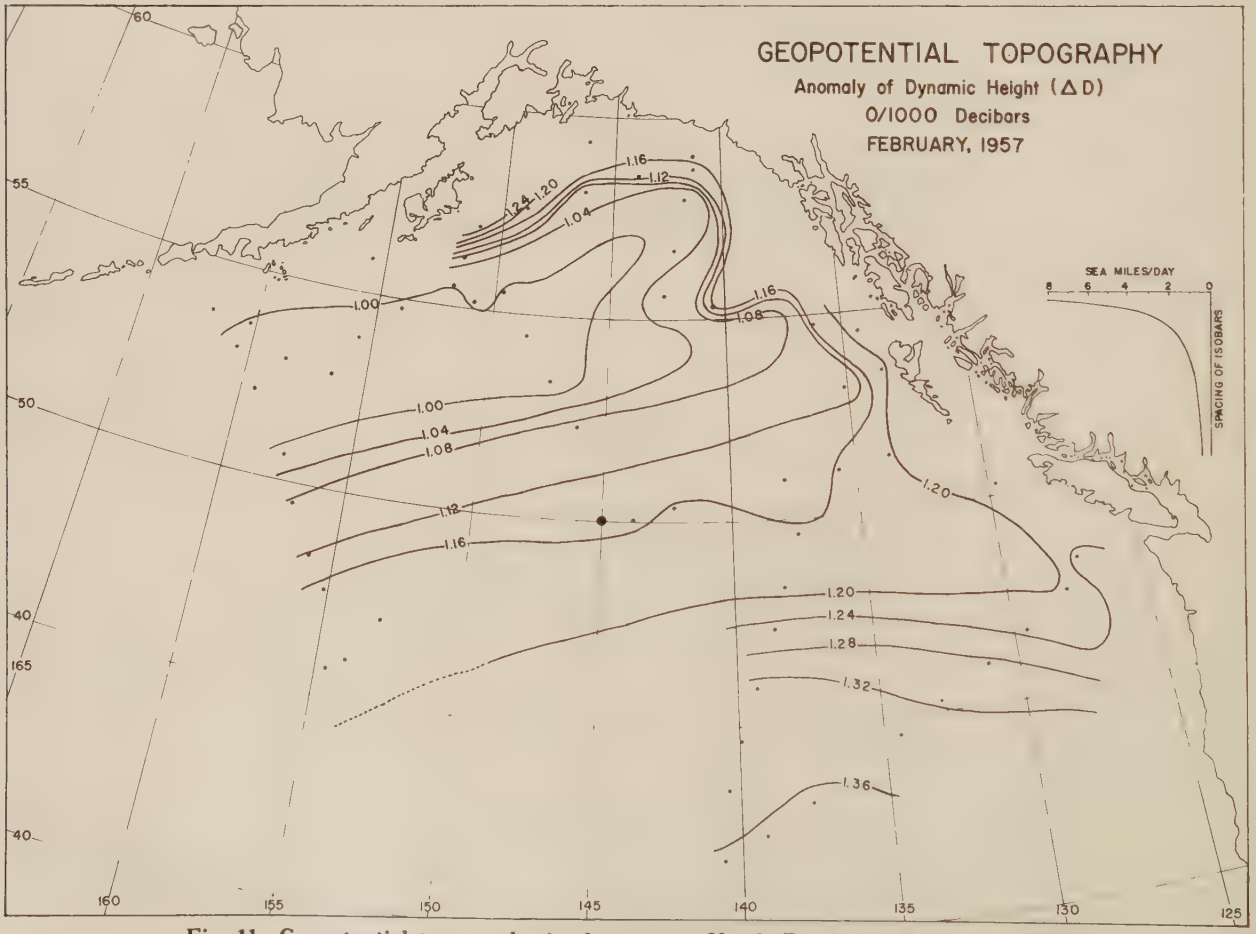

Fig. 11. Geopotential topography in the eastern North Pacific in February, 1957.

B. BIOLOGICAL INVESTIGATIONS IN THE NORTH PACIFIC IN 1957

UNDER THE RESEARCH PROGRAM OF THE INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

by the Fisheries Agency of Japan

REPORT OF SALMON INVESTIGATIONS CONDUCTED IN THE NORTH PACIFIC IN 1957

Introduction:

This report is a summary of the results of the compilation, up to the present time, of data obtained from the mothership fishery, which operated from early May to late July, 1957, in the North Pacific, and data collected by the government research vessels *Etsuzan-maru, Kano-maru* and *Tenyo-maru,* which conducted investigations from early May to mid-August, 1957.

The items and order of the compilation are in conformity with those of the research program adopted at the 1954 Annual Meeting of the International North Pacific Fisheries Commission.

1. OFFSHORE DISTRIBUTION

A. Collection and Analysis of Records of Commercial Catches

The statistics of the mothership salmon fishery in Aleutian waters in 1957 are now being compiled. The salmon catches in these waters are summarized in Figure 1 and Tables 1 and 2.

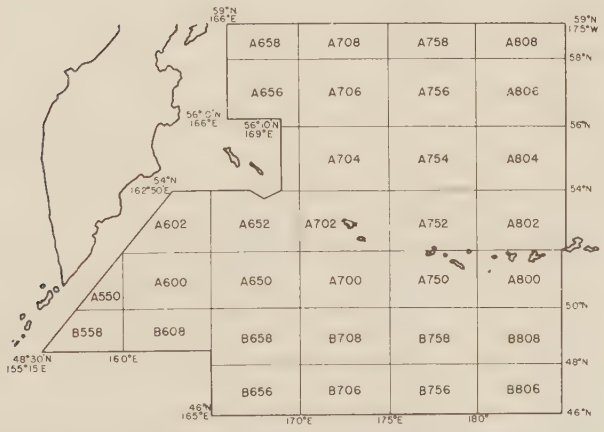

Fig. 1. Statistical areas for the salmon mothership fishery in Aleutian waters.

TABLE 1. Catch of the Mothership Salmon Fishery in Aleutian Waters, by Species, 1957.

Week	Sockeye		Chum		Pink		Coho		Chinook		Totals	
	Number	Weight*	Number	Weight*	Number	Weight*	Number	Weight*	Number	Weight*	Number	Weight*
May 5 - 11	1,017,416	1,982,434	592,958	1,052,988	8,597	9,423			224	1,425	1,619,195	3,046,270
May 12 - 18	1,788,392	3,738,138	1,236,891	2,276,820	25,986	31,867	2	3	847	4,949	3,052,118	6,051,777
May 19 - 25	1,965,862	4,065,523	1,250,414	2,243,751	114,726	137,792	8	11	683	3,790	3,331,693	6,450,867
May 26 - June 1	1,346,678	2,759,118	933,351	1,661,201	250,558	308,582	31	43	585	3,090	2,531,203	4,732,034
June 2 - 8	1,790,004	3,745,607	1,468,510	2,766,488	914,198	1,155,100	299	472	1,170	6,365	4,174,181	7,674,032
June 9 - 15	3,251,591	7,205,793	1,264,016	2,299,174	2,584,993	3,266,521	684	1,184	4,889	13,877	7,106,173	12,786,549
June 16 - 22	3,148,988	7,014,151	671,580	1,257,616	1,664,377	2,153,241	531	945	3,332	8,191	5,488,808	10,434,144
June 23 - 29	1,638,763	3,598,897	543,420	1,040,702	2,326,776	3,025,954	3,366	6,104	9,337	21,640	4,521,662	7,693,297
June 30 - July 6	1,515,900	3,031,756	432,067	772,070	4,373,336	5,634,930	24,358	45,937	2,559	7,122	6,348,220	9,491,815
July 7 - 13	1,233,598	2,513,876	474,981	892,189	5,005,648	6,415,228	125,271	260,303	3,706	10,799	6,843,204	10,092,395
July 14 - 20	1,041,570	2,174,066	326,797	628,587	3,582,498	4,757,671	152,909	342,493	3,405	10,344	5,107,179	7,913,161
July 21 - 27	83,778	178,642	51,147	104,213	193,892	271,006	32,164	80,436	367	1,163	361,348	635,460
Total	19,822,540	42,008,001	9,246,132	16,995,799	21,045,585	27,167,315	339,623	737,931	31,104	92,755	50,484,984	87,001,801

* In kilograms

TABLE 2. Catch of the mothership salmon fishery in Aleutian waters, by species, by month and by area, with amounts of gear used, 1957. (Including catches by scouting boats).

Month	Area	Sockeye	Chum	Pink	Coho	Chinook	Total	Number of Tans
		Number	Number	Number	Number	Number	Number	
May	B 608	563,834	434,942	24,903	1	182	1,023,862	184,118
	B 656	520,414	152,328	39,449	3	79	712,273	160,846
	B 658	999,866	505,241	67,184	8	231	1,572,530	305,482
	B 708	235,642	101,818	21,723	1	84	359,268	97,510
	A 600	37,468	67,445	655	1	29	105,598	30,855
	A 650	1,396,694	1,114,637	46,309	6	643	2,558,289	491,342
	A 652	317,156	346,046	589		200	663,991	122,585
	A 700	1,350,645	830,814	99,661	5	580	2,281,705	480,500
	A 702	364,147	257,748	621		153	622,669	117,620
	A 750	100,460	40,566	29,874	9	90	170,999	40,722
Sub-Total		5,886,326	3,851,585	330,968	34	2,271	10,071,184	2,031,580
June	B 558	11,877	143,933	41,278		29	197,117	28,914
	B 608	696,629	588,193	652,829	70	268	1,937,989	233,146
	B 656	226,359	81,344	189,723	503	76	498,005	71,528
	B 658	474,310	211,471	422,548	305	183	1,108,817	134,372
	A 600	551,043	322,030	720,034	2,343	331	1,595,781	188,330
	A 602	643,107	343,393	603,261	1,613	362	1,591,736	222,885
	A 650	532,735	447,161	810,541	675	588	1,791,700	229,278
	A 652	643,815	298,241	848,680	1,763	485	1,792,984	224,054
	A 700	916,930	564,176	1,067,749	236	1,204	2,550,295	279,271
	A 702	697,997	501,254	330,591	64	1,014	1,530,920	190,678
	A 704	27,359	13,418	5,053		205	46,035	9,504
	A 750	197,334	53,566	260,347	69	136	511,452	47,305
	A 752	1,590,694	183,829	508,437	3	1,896	2,284,859	193,171
	A 754	330,816	81,939	179,665	3	1,043	593,466	62,942
	A 756	11,656	3,292	66,652	41	24	81,665	8,910
	A 758	154,665	48,315	184,265	2	1,650	388,897	53,587
	A 802	634,612	50,429	155,423	15	253	840,732	92,084
	A 804	979,518	105,495	753,465	13	2,018	1,840,509	217,834
	A 806	723,996	79,457	299,923	4	4,309	1,107,689	152,361
	A 808	276,963	56,147	220,161	4	3,056	556,331	101,930
Sub-Total		10,322,415	4,177,083	8,320,625	7,726	19,130	22,846,979	2,742,084
July	B 558	17,504	95,040	1,717,911	111,954	934	2,043,340	207,777
	B 608	37,025	36,875	1,151,634	54,417	520	1,280,471	92814
	B 658	7,991	2,413	18,206	304	1	28,915	4,494
	A 550	292,338	139,888	1,751,574	26,238	578	2,210,616	162,282
	A 600	942,419	305,614	3,931,339	81,546	1,788	5,262,706	519,448
	A 602	1,359,411	359.449	1,451,157	30,082	2,978	3,203,077	439,704
	A 650	67,257	18,200	102,750	13,347	271	201,825	28,666
	A 652	573,774	84,288	953,696	12,993	1,087	1,625,838	186,719
	A 656	45,206	6,645	210,669	355	69	262,944	23,682
	A 658	27,109	15,679	146,020	307	102	189,217	15,510
	A 704	34,740	7,797	261,661	93	35	304,326	33,068
	A 706	5,537	3,407	63,664	6	80	72,694	8,470
	A 708	15,509	9,544	60,905	18	247	86,223	15,360
	A 756	17,692	11,078	116,096	34	72	144,972	17,907
	A 758	22,849	5,563	116,261	151	111	144,935	17,770
	A 806	27,817	64,122	267,316	16	499	359,770	45,040
	A 808	19,621	51,862	73,133	5	331	144,952	26,714
Sub-Total		3,613,799	1,217,464	12,393,992	331,863	9,703	17,566,821	1,845,425
Total		19,822,540	9,246,132	21,045,585	339,623	31,104	50,484,984	6,619,089

B. Collection of Scientific Data by Research Vessels

The following two vessels engaged in research as government research vessels:

Kano-maru: steel vessel; 152 gross tons; 330 horsepower.

Etsuzan-maru: steel vessel; 153 gross tons; 330 horsepower.

The research vessels were principally concerned with obtaining data regarding the problem of the Abstention Line (175° West), however, during the period after July 20 they operated mostly in the area west of 170° E. and north of 50° N. The details of their operations are shown in Tables 3A and 3B and Figure 2. The following is a summary of the research operations:

Name of Vessel	Left Hakodate	Began Investigations	Entered Adak	Left Adak	Completed Investigations	Entered Hakodate	No. of Stations (inc. oceanographic observations)
Kano-maru	May 11	May 14	July 1	July 5	Aug. 9	Aug. 17	68
Etsuzan-maru	May 11	May 14	July 1	July 5	Aug. 2	Aug. 10	55

TABLE 3A. Result of Salmon Investigation in the North Pacific, 1957.

Kano-maru

Date of Set	Location of Set Lat.	Long.	Surface W.T.	Direction of Nets	Number of Tans Used	Catch in Number of Fish Sockeye	Chum	Pink	Coho	Chinook	Total
5 - 18	49 - 00 N	165 - 00 E	3.2°C	ESE	30	44	22	20			86
5 - 19	48 - 02 N	167 - 22 E	3.4	NE/N	30	129	66	9			204
5 - 21	48 - 08 N	167 - 40 E	3.8	NNE	30	109	37	10			156
5 - 23	49 - 15 N	167 - 56 E	3.9	NNE	30	23	7				30
5 - 24	49 - 13 N	169 - 00 E	3.6	NE	28	30	51	24			105
5 - 25	49 - 45 N	170 - 24 E	5.1	S	28	48	38	25			111
6 - 1	49 - 37 N	171 - 00 E	5.9	SE	28	41	26	45			112
6 - 6	49 - 55 N	175 - 02 E	5.4	W	28	35	32	158			225
6 - 8	50 - 05 N	179 - 56 E	5.9	SSE	28	2	14	162			178
6 - 10	49 - 05 N	179 - 50 E	6.3	ESE	28	4	26	82			112
6 - 11	50 - 15 N	179 - 30 E	6.1	E	28	7	12	22			41
6 - 12	50 - 20 N	179 - 34 W	5.9	E	28	35	8	81			124
6 - 19	51 - 22 N	171 - 18 W	7.5	W	29	28	18	200		1	247
6 - 20	50 - 30 N	170 - 18 W	7.5	N	29	3	19	95			117
6 - 21	50 - 53 N	169 - 50 W	8.6	ESE	29	18	12	64			94
6 - 22	51 - 11 N	169 - 28 W	8.2	SE	29	10	5	22			37
6 - 24	51 - 21 N	170 - 21 W	7.8	SW	29	24	24	95			143
6 - 27	55 - 16 N	176 - 55 W	6.2	E	29	77	22	216			315
6 - 28	55 - 42 N	177 - 35 W	6.6	NE	29	37	8	819			864
6 - 29	55 - 16 N	176 - 55 W	6.9	N	29	17	58	283			358
7 - 7	56 - 10 N	164 - 41 W	11.0	SE	29	44	67	3			114
7 - 8	56 - 08 N	166 - 30 W	10.5	S/W	29	11	22	2	2		37
7 - 15	58 - 16 N	167 - 22 E	11.2	N	27	97	21	390			508
7 - 16	58 - 17 N	167 - 10 E	11.4	N	27	116	110	445			671
7 - 19	52 - 37 N	162 - 08 E	11.9	NNW	27	93	86	30			209
7 - 20	53 - 34 N	163 - 15 E	11.9	NW	27	28	54	40	1		123
7 - 21	53 - 33 N	162 - 52 E	11.8	NW	27	52	45	45			142
7 - 24	51 - 31 N	160 - 10 E	10.2	NW	27	43	90	30			163
7 - 25	52 - 02 N	161 - 04 E	10.9	NE	29	29	73	19	8		129
7 - 26	51 - 06 N	160 - 08 E	9.7	NNE	28	18	32	71	8		129
7 - 27	51 - 52 N	160 - 51 E	11.4	NE/N	28	53	43	26	12		134
7 - 28	52 - 16 N	162 - 00 E	11.1	NNE	27	50	73	7	15	1	146
7 - 29	52 - 32 N	163 - 00 E	12.0	NW	27	43	110	4	4		161
7 - 30	52 - 40 N	164 - 48 E	11.4	NNW	27	41	59		9	1	110
7 - 31	53 - 17 N	166 - 55 E	11.6	WNW	27	71	35		8		114
8 - 2	53 - 30 N	167 - 14 E	10.6	WSW	27	48	118		18	1	185
8 - 4	52 - 50 N	168 - 45 E	10.3	ESE	27	67	35	1	3		106
8 - 5	53 - 57 N	166 - 23 E	11.0	E/S	27	84	45		6		135
8 - 6	53 - 54 N	164 - 32 E	13.8	NW/N	27	73	49		23		145
8 - 8	53 - 51 N	163 - 03 E	13.9	NNW	27	52	69		5		126
		Total			1,124	1,834	1,741	3,545	122	4	7,246

TABLE 3B. Result of Salmon Investigation in the North Pacific, 1957.

Etsuzan-maru

Date of Set	Location of Set Lat.	Long.	Surface W.T.	Direction of Nets	Number of Tans Used	Catch in Number of Fish Sockeye	Chum	Pink	Coho	Chinook	Total
5 - 21	51 - 16 N	169 - 02 E	4.0°C	SW	30	63	64	2			129
5 - 22	51 - 58 N	169 - 30 E	4.5	SSW	30	56	34	1		1	92
5 - 25	52 - 31 N	168 - 27 E	4.0	W	30	47	15				62
5 - 26	52 - 02 N	169 - 26 E	4.2	NE	30	78	53				131
5 - 31	49 - 02 N	167 - 25 E	3.9	SSE	30	49	38	51			138
6 - 1	50 - 03.5 N	166 - 47 E	3.5	SSE	30	54	47	8			109
6 - 5	52 - 56 N	170 - 32 E	4.5	SW	30	66	71		1		138
6 - 7	52 - 42 N	179 - 17 E	4.9	N	30	41	20	17			78
6 - 9	52 - 42 N	178 - 26 W	5.8	N	30	109	30	278			417
6 - 11	52 - 37 N	177 - 51.2 W	5.3	NNW	30	80	7	31			118
6 - 12	52 - 35 N	176 - 11 W	5.7	NNW	28	29	12	154			195
6 - 13	52 - 42 N	176 - 00 W	6.5	W	23	104	28	211			343
6 - 14	53 - 12 N	177 - 50 W	—	SE/S	28	53	10	108			171
6 - 15	54 - 51 N	178 - 00 W	6.2	ESE	28	346	8	78			432
6 - 21	55 - 20 N	169 - 20 W	8.0	NE	28	48	5	51		1	105
6 - 23	55 - 56 N	168 - 44 W	9.2	S/E	28	261	28				289
6 - 24	56 - 30 N	168 - 30 W	9.7	S	28	210	19				229
7 - 6	54 - 28 N	179 - 26 W	7.9	WSW	28	4	8	48			60
7 - 7	56 - 28.8 N	179 - 40 W	9.0	E	28	1	11	79			91
7 - 9	57 - 22 N	179 - 52 W	—	SE	28	13	93	11			117
7 - 10	57 - 19.5 N	179 - 21 E	—	NE	28	8	45	10			63
7 - 13	53 - 09.5 N	171 - 19 E	8.1	NNW	28	64	36	92			192
7 - 15	52 - 30 N	163 - 20 E	8.8	E/S	28	28	27	37	2		94
7 - 16	52 - 40 N	162 - 25 E	9.2	NE/E	28	36	33	111			180
7 - 17	52 - 45 N	162 - 30 E	11.0	SSE	28	71	18	92			181
7 - 18	53 - 11 N	162 - 36 E	11.6	SE/S	28	61	37	76			174
7 - 19	52 - 55 N	162 - 46 E	10.6	SE	28	30	10	41			81
7 - 20	53 - 38.5 N	162 - 50 E	11.0	NNE	28	30	8	48			86
7 - 21	52 - 30 N	162 - 48 E	10.7	NW	28	11	6	24			41
7 - 24	51 - 25 N	160 - 06 E	9.6	NNE	28	11	46	96	9		162
7 - 25	51 - 58 N	160 - 52 E	—	S	28	19	51	49	34		153
7 - 26	51 - 30 N	161 - 10 E	9.4	NE	28	59	32	102	23		216
7 - 27	52 - 02 N	160 - 00 E	—	W	28	10	34	11	14	1	70
7 - 28	52 - 03 N	162 - 52 E	10.8	SW/S	28	27	23	10	40		100
7 - 29	52 - 22 N	164 - 04 E	10.7	SSW	28	84	139	4	79		306
7 - 30	52 - 24 N	164 - 50 E	11.4	NNE	28	93	78	32	28		231
7 - 31	52 - 13 N	165 - 39 E	11.8	NE	28	48	16	2	119		185
8 - 1	52 - 07.5 N	166 - 57 E	10.4	NE	28	61	23	6	45		135
		Total			1,079	2,463	1,263	1,971	394	3	6,094

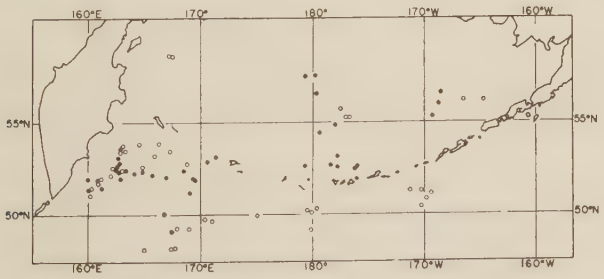

Fig. 2. Locations of sets by research vessels.
Open circles — *Kano-maru*
Solid circles — *Etsuzan-maru*

Gillnets and longlines were carried as gear, but the longlines were used only once and caught no salmon. The gillnets used conformed to the specifications agreed upon by the INPFC. One set of standard nets is composed of six shackles (50 fathoms each) of nets of four different mesh sizes connected in the following order: 2½ inches, 4½ inches, 3¼ inches, 4½ inches, 5¼ inches and 4½ inches.

The amount of standard nets of each mesh size actually used by the two vessels was as follows:

Size	No. of Shackles Kano-maru	Etsuzan-maru
2½	4 – 5	5
4½	4	5
3¼	3 – 5	4 - 5
4½	5	5
5¼	4 – 5	5
4½	5	5

Both vessels also used certain amounts of nets of a different mesh size (4 sun or 4¾ inches) for the purpose of catching fish for tagging experiments and collecting samples for exchange. The catches of the two vessels in the standard nets were as follows:

Name of Vessel	Sockeye	Pink	Chum	Coho	Chinook	Total	Shackles Used
Kano-maru	1834	3545	1741	122	4	7246	1124
Etsuzan-maru	2463	1971	1263	394	3	6094	1079

Results of Fishing by Research Vessels

As different areas were covered at different times it is difficult to generally state the distribution of fish; however, the results of fishing for each species were as follows:

Sockeye

Sockeye were caught in the southern vicinity of Attu in late May. Thereafter the catch decreased as fishing proceeded eastward in waters south of the Aleutian chain, and some small fish (25 - 35 cm.) were caught south of Kiska Island in early June. On the other hand in waters north of the chain the catches were fairly good (mid and late June). In an area south of Cape Olyutorski the proportion of smaller fish (30 - 40 cm.) increased (mid-July). Sockeye were caught at each station in the areas from south of the Commander Islands to off the southern shore of the Kamchatka Peninsula; small fish (30 - 40 cm.) also were caught.

Chum

Catches were made in all the areas fished from mid-May through early August, but the catches were in general smaller than those of sockeye. Smaller fish (30 - 40 cm.) were widely distributed in the waters south of the Commander Islands. Also in early July many smaller fish (30 - 35 cm.) were taken in the vicinity of 180° longitude north of 55° N.

Pink

While few pinks were found in the southern vicinity of Attu Island in late May, they were abundant in waters both south and north of the Aleutian Chain east of 180° in early and mid-June, but catches decreased in late June. Considerable catches were made south of Cape Olyutorski in mid-July. The catch gradually decreased after mid-July in the area south of the Commander Islands and very few fish were caught after the beginning of August.

Coho

Coho appeared in the areas south of the Commander Islands from late July on.

2. IDENTIFICATION OF STOCKS

A. Morphological Studies

(a) Analysis of Commercial Catches

Measurements and scale samples were taken on most of the sixteen mothership fleets. Fourteen fleets operated in the North Pacific and the remaining two were in the Sea of Okhotsk. For each fleet and on each day of fishing the fork length, body weight, gonad weight, and sex were recorded for 30 each of sockeye, chum and pink and on 15 each of coho and chinook; scale samples were taken at the same time.

For sockeye and chum salmon age determinations were made on all the scales collected and sample age compositions are compiled by ten-day periods by sex and for each area of 5° longitude by 2° latitude. Also length compositions were compiled for each age category. For pink salmon, length compositions were compiled, as a principle, for each area of 5° latitude and 2° longitude (sometimes for a larger area) and by sex. Also the frequency distribution of gonad weights of sockeye, chum and pink salmon was compiled by ten-day periods and by areas.

The results of the above compilation are now being analyzed together with data from other phases of the program for the purpose of identifying stocks.

(b) Investigation by Research Vessels

As a principle, each research vessel measured all the fish caught by nets of each mesh size in one standard set and scales were taken from them. The length composition by species by mesh size is shown in Figures 3A — 3D.

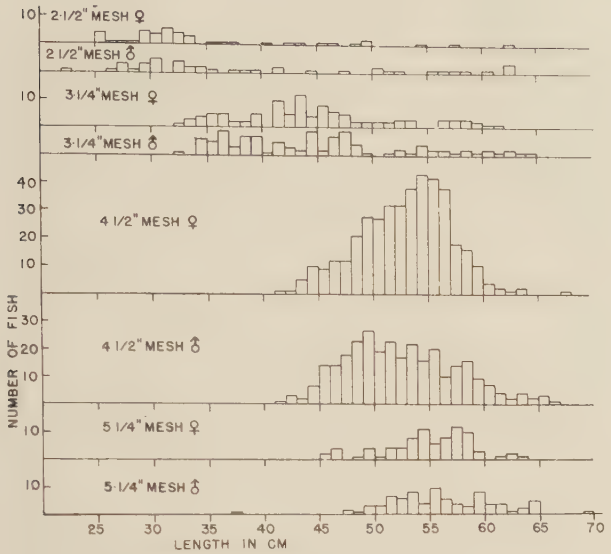

Fig. 3A. Length composition by mesh size, sockeye.

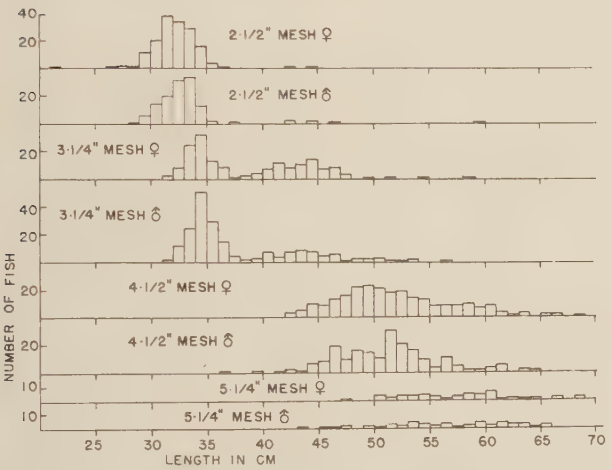

Fig. 3B. Length composition by mesh size, chum.

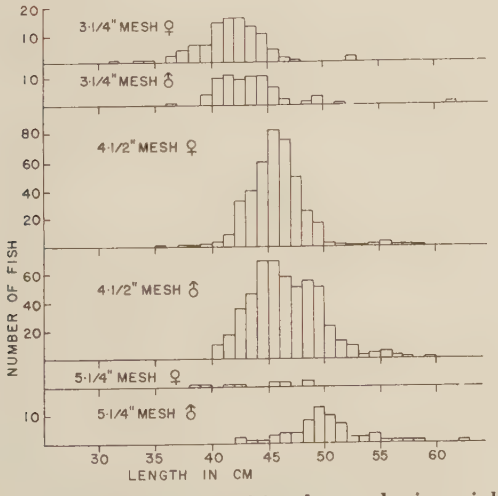

Fig. 3C. Length composition by mesh size, pink.

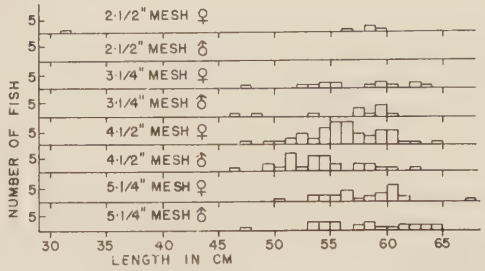

Fig. 3D. Length composition by mesh size, coho.

Sockeye

2½″ mesh: The range of the length frequency distribution is very wide, covering from 23 cm. to 63 cm.; the mode being at about 31 cm.

3¼″ mesh: Body lengths range from 33 cm. to 65 cm. with the mode at about 42.3 cm., which is closer to the lower limit.

4½″ mesh: Lengths range from 41 cm. to 68 cm. with the mode at about 55.6 cm. The ranges of length distribution of both sexes are the same but the mode is at 55 cm. for females and at 50 cm. for males.

5¼″ mesh: Most of the fish caught by nets of this mesh size were 46 cm. and larger, the mode being at 55.6 cm.

Chum

2½″ mesh: Most of the fish fell in the small range between 27 cm. and 38 cm., with the mode at 33 cm. Some fish of about 45 cm. were also caught.

3¼″ mesh: The major mode was at about 35 cm. and a smaller mode was at about 45 cm. The distribution spreads towards the larger lengths.

4½″ mesh: Most of the fish were 45 cm. and larger, the mode being at 52 cm.

5¼″ mesh: Most of the fish were 50 cm. and larger, and the mode was at 61 cm., but it is not as distinctive as in the catches of other mesh sizes, because the number of specimens was small.

Pink

2½″ mesh: No pinks were caught in nets of this mesh size.

3¼″ mesh: The lower limit of the distribution is at 35 cm. and the mode is at 42 cm.

4½″ mesh: The length distribution ranges from 40 cm. to 60 cm. and the mode is at 46 cm.

5¼″ mesh: The mode is at 50 cm.

Coho

No remarkable relationships are seen between the length and mesh size and all the fish were 46 cm. and larger.

(c) **Scale Studies**

(1) **Sockeye**

Observations were made on changes in the proportions of different age categories of sockeye salmon caught in ocean waters according to time and area. The proportions of fish of different fresh water years are being reviewed through this study. Furthermore, estimation of the growth rates during the fresh water and ocean periods, by means of certain marks on scales and by study of the differences in the number of circuli of scales, are now being made.

(2) **Chum**

As it is considered that the so-called "river mouth ring", which is an area of circuli with narrow intervals formed inside of the first annulus, shows differences between various stocks and that it could be an effective means of distinguishing stocks, the measurement and analysis of this particular part of the scale is now being made on chum salmon obtained from the whole area of the North Pacific.

(3) **Pink**

A major effort was made on the analysis of differences in the offshore distribution, growth rate, maturity, etc.

The study of the pink scale itself remained only preliminary.

B. **Bio-Chemical Studies**

For study of the identification of stocks by means of serological reactions samples were obtained by the two government research vessels and from the two motherships operated in the Sea of Okhotsk and in the northwestern part of the Pacific Ocean. More than 4,000 salmon of the five species, including 230 sockeye, were sampled. Of this total 186 sockeye, chum and pink combined were sampled by the government research vessels at seven stations (50° N. – 57° N., 163° E. - 169° W.) during the period from early June through early July.

An analysis of these samples is now being made and serological differences in sockeye blood have been determined by using the antisera absorption test. As a result, differences between sampling areas and sampling periods have been recognized.

C. **Parasitological Studies**

The parasitological studies in 1957 were conducted on parasites from chum salmon entering the streams of Hokkaido. Collections were made from Hatano in Kitami, Abashiri, and two locations in Nemuro and Tokachi. At each station the body surface, gills, intestines and air bladder were examined for each of ten females and ten males after egg collection for artificial hatching. No parasites were obtained from the gills or the air bladder. Many larval tapeworms were found in the intestines and also specimens of *Eubothrium* in various stages of development were recognized. Also a small number of *Echinorhynchus gadi* were collected for the first time. The parasites were brought back preserved in formalin with the walls and contents of the intestines and are now being studied. The reason samples were collected from stations in eastern Hokkaido as mentioned above is that the largest chum salmon runs were mostly found in this region in 1957.

3. STUDY OF MOVEMENTS BY TAGGING

A total of 896 salmon were tagged and released by the two research vessels. All the tags used in the first half of the season were of the Atkins type (celluloid) and the tags were affixed to the peduncle with a copper wire. Part of the fish released during the second half of the period were tagged with a vinyl tube fixed through the base of the dorsal fin. All the fish were caught by gillnets and those of good condition were chosen for tagging. Measurements were not taken and determination of maturity was not made at the time of release and scales were collected from only a part of the tagged fish. The number of released fish by area and by species and the results of recapture as of January 31, 1958, are shown in Table 4 and Figure 4. Sockeye salmon were most numerous among both releases and recaptures. The fact that sockeye were most numerous in the catches and were in good condition and some other factors account for this result.

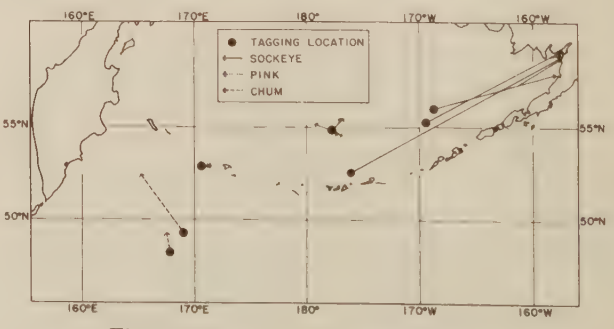

Fig. 4. Recapture of tagged salmon.

TABLE 4. Result of Tagging Experiments. (As of February, 1958).

Name of Vessel	Release									Recapture			
	Area *	Period	Type and Mark of Tag	Number of fish released					Total	Species	Tag No.	Date	Position
				Sockeye	Chum	Pink	Coho	Chinook					
Kano-maru	N W	5.20 - 6.2	Atkins Hokkaido Res. Lab. D	138	55	6			199	Chum	89	5.24	49 - 14 N 167 - 26 E
										Chum	165	7.8	52 - 31 N 165 - 08 E
	N M	6.7 - 6.12	Atkins Hokkaido Res. Lab. D	8	4	9			21				
	B E	6.28 - 6.29	Atkins Hokkaido Res. Lab. D	2		2			4				
	N W	7.24	Atkins Hokkaido Res. Lab. D	10	2	12			24				
Total				158	61	29			248				
Etsuzan-maru	N W	6.6	Atkins Hokkaido Res. Lab. A	26	18				44	Sockeye	1020	6.7	53 - 04 N 171 - 27 E
										Sockeye	1034	6.11	52 - 54 N 171 - 14 E
	N M	6.8 - 6.16	Atkins Hokkaido Res. Lab. A	244	34	92			370	Sockeye	1446	6.19	54 - 40 N 177 - 14 E
										Pink	1373	6.19	55 - 10 N 179 - 14 W
										Sockeye	1384	6.21	55 - 27 N 176 - 46 W
										Sockeye	1383	6.21	55 - 27 N 176 - 54 W
										Sockeye	1453	6.22	54 - 32 N 176 - 54 W
										Sockeye	1335	7.4	Johnston Hill, Bristol Bay
	N M	7.7	Atkins Hokkaido Res. Lab. A	1	1	5			7				
	B E	6.22 - 7.10	Atkins Hokkaido Res. Lab. A	184	4	17		1	206	Sockeye	1536	7.4	Johnston Hill, Bristol Bay
										Sockeye	1632	7.8	Off Ugashik, Bristol Bay
										Sockeye	1637	7.9	Johnston Hill, Bristol Bay
										Sockeye	1507	7.13	Telephone Pt., Bristol Bay
										Sockeye	1511	7.8	Naknek, Bristol Bay
	N W		Spaghetti J	8	6	5	2		21				
Total				463	63	119	2	1	648				
Grand Total				621	124	148	2	1	896				

* N W — 40 - 55°N, 160 - 177°E; N M — 47 - 55°N, 177°E - 165°W; B W — West of 177°E, north of 55°N; B E — 177°E - 165°W, north of 55°N.

4. OCEANOGRAPHY

A training vessel of the Fisheries Department of Hokkaido University, *Oshoro-maru,* investigated the salmon fishing grounds of the northern North Pacific and the southern Bering Sea close to the Aleutian Islands (48° – 54° N; 158° E – 171° W.) during the period of June 19 to July 16. The research vessel of the Fisheries Agency, *Tenyo-maru,* covered the areas between 41° N. and 56° N. and 144° E. and 170° W. during the period of July 8 to August 6. Observations were also made by the government research vessels *Kano-maru* and *Etsuzan-maru* at 40 and 38 stations, respectively. The *Oshoro-maru* obtained water temperature data and sea water samples from each level down to 1,500 meters at 37 stations and the data were obtained on water temperatures, chlorinities, dissolved oxygen content and inorganic phosphate content. The *Tenyo-maru* measured water temperatures by use of reversing thermometers at 56 stations and chlorinities were subsequently determined at the Yoichi laboratory. It is planned that the data collected will be analysed at Hokkaido University and the Hokkaido Regional Fisheries Research Laboratory. Samples of zooplankton were obtained at all stations by towing a standard North Pacific net vertically from a depth of 150 meters, and samples of phytoplankton were also collected from all stations by towing a Kitahara net vertically from a depth of 100 meters by the *Tenyo-maru* and *Oshoro-maru.* The speed of the vertical tow was 1 meter per second. A fish larva net was also towed horizontally at each station.

The samples of zooplankton are now being studied in comparison with the distribution of food plankton and samples of phytoplankton are being studied as a possible index of organic productivity. The stomach contents of salmon of various species are being analyzed for the purpose of relating the distribution and movements of salmon in certain areas to the distribution and quantity of plankton in the same areas.

It is expected that the results and detailed information on these studies will be published in the near future.

REPORT OF THE KING CRAB STUDY IN THE EASTERN BERING SEA

By the Fisheries Agency of Japan

Research in 1957 was conducted by a research worker aboard the crab mothership as in 1956.

Collection and Analysis of Records of Commercial Catches

(1) Records of Commercial Operations

King crab fishing was by tangle nets only in 1957. Records of the operation were kept in the same way as in the previous years. The average number of crabs caught per shackle (tan) of tangle nets in 1957 was higher than in any of the years 1953 - 1956. It is also higher than in any of the pre-war years in which the crab operation was conducted in this area. By examining the catches by month it is noted that the increase in catch in the tangle net grounds around Amak Island at the beginning of the fishing season was especially large (see Table 1). The tangle net grounds of 1957 are shown in Figure 1 and the canned crab production is shown in Table 2. During the period of June 23 to June 29 one catcher boat, for the purpose of finding new crab grounds, cast scouting nets at 67 stations in the eastern vicinity of the Pribilof Islands (see Figure 2). The rensults are shown in Table 3. While catches of Aburagani *(P. platypus)* and tanner crabs were obtained, no king crabs were found in this area.

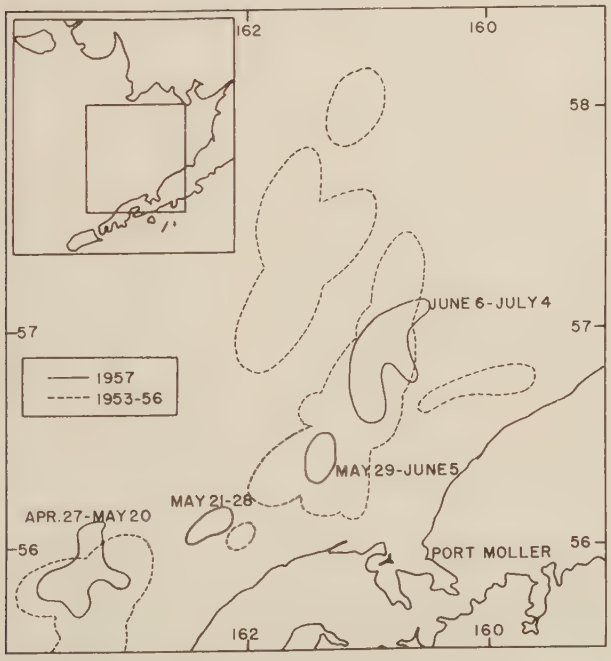

Fig. 1. Tangle net grounds, 1957.

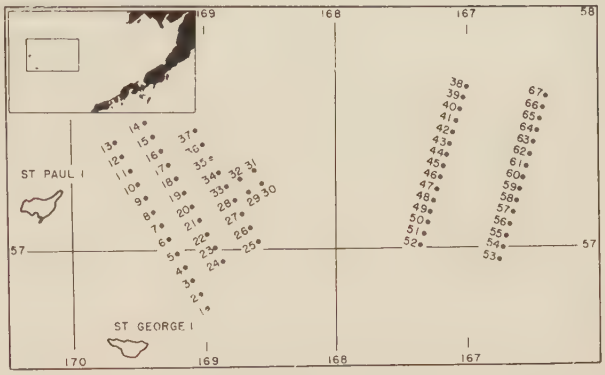

Fig. 2. Locations of fishing by scouting nets in waters east of the Pribilof Islands.

(2) Composition of Catch

The proportions of crabs of different categories were studied using as a basis the records of the scouting net operation in 1957; namely male crabs of legal size (not smaller than 130 mm. in carapace width), new shell males (male crabs of legal size with a new carapace), under sized male crabs, female crabs and tanner crabs. The scouting nets were cast in sets of about five shackles each by a catcher boat and usually left for 24 hours before being hauled in. Fifteen sets of such scouting nets were cast over wide areas every day with intervals between sets of 2 - 3 nautical miles, for the purpose of locating crab schools. In comparing the results of 1955, 1956 and 1957 (see Table 4) the proportion of male crabs of legal size in 1957 is extremely high. Also it is noticed that the proportions of new shell males and under sized males were smaller in 1957. This is considered to be a result of the early completion of the operation in 1957 (in early July). In other words the northern parts of the crab grounds of usual years were not utilized in 1957. The average catch of male crabs of legal size per shackle for the past three years is as follows:

Year	*Scouting Nets* (from Table 4)	*Tangle Nets* (from Table 2)
1955	5.6 crabs	11.4 crabs
	(6.9 crabs excluding those caught in April and August)	
1956	4.8 crabs	7.3 crabs
1957	9.8 crabs	14.0 crabs

Except in April, 1955, when both king crabs and tanner crabs were packed from the catches of scouting nets and August, 1955, when tanner crabs were packed from the catches of scouting nets, there seems to be a fair coincidence between the yearly fluctuations in the average number of crabs per shackle of tangle nets and those of scouting nets. It cannot be said that the average number of male crabs (of legal size) per shackle of tangle nets or scouting nets represents the stock level. However, it can be conjectured that in 1957 male crabs (of legal size) were extremely abundant in the waters covered by tangle nets, and they were also more abundant than in usual years in the broader waters fished by scouting nets.

Identification of Stocks

The carapace length was measured for 4,720 sample crabs from the catch. Analysis of these data is being continued.

TABLE 1. King Crab catch by month, 1957.

* Period	** No. of "tans" hauled	No. of days net soaked	No. of crabs caught	Crabs per "tan"	No. of cases packed
April 27 - 30	4,939	3.0	60,553	12.3	2,643
May 1 - 31	37,016	11.8	517,744	14.0	26,224
June 1 - 30	34,130	16.2	547,316	16.0	28,234
July 1 - 4	7,547	10.5	45,338	6.0	2,749
Total	83,632	13.0	1,170,951	14.0	59,850

* The date hauling was begun.

** "Tan" is a unit of nets; one "tan" of crab tangle nets measures about 130 feet at the lead line.

TABLE 2. King Crab pack, 1957.

* Days of operation	No. of motherships	**No. of catcher boats	*** No. of net hauling boats	No. of "tans" hauled	No. of crabs caught	Catch per "tan"	****No. of cases packed	No. of crabs per case
70	1 (5,385 G.T.)	3	8	83,532	1,170,951	14.0	59,850	19.5

* From April 26 — July 4.

** Catcher boats are used for casting tangle nets and for casting and hauling scouting nets.

*** Tangle net hauling boats deckloaded on the mothership.

**** One case contains 4 dozen half-pound cans; however, in 1957 49,850 cases of 48 half-pound cans and 10,000 cases of 24 one-pound cans were packed.

TABLE 3. Records of fishing by scouting nets in waters east of the Pribilof Islands, 1957. 1) 2)

Date of set	No.	Location		Depth	Aburagani *(P. platypus)*				Tanner crabs	Water temp. °C.	
		Latitude N	Longitude W		Males	New-shelled males	Under-sized males	Females		Surface	Bottom
June 23	1	56° - 45′	168° - 58′	95	0	0	0	0	9	8.2	2.54
	2	56 - 48.5	169 - 01	87	1	0	0	0	22		
	3	56 - 52	169 - 05	84	7	0	0	0	14		
	4	56 - 56	169 - 08	81	8	0	0	0	29		
	5	56 - 59	169 - 11.5	79	12	0	0	2	8		
	6	57 - 02.5	169 - 15	76	12	0	0	0	10		
	7	57 - 06	169 - 19	75	4	0	0	1	16	8.6	2.98
	8	57 - 09	169 - 22.5	72	6	0	0	0	12		
	9	57 - 13	169 - 26	72	9	0	2	1	13		
	10	57 - 16	169 - 29.5	69	1	0	0	0	8		
	11	57 - 20	169 - 33	66	1	0	1	0	13		
	12	57 - 23	169 - 37	65	6	0	0	1	13		
	13	57 - 26.5	169 - 40	68	4	0	0	1	32	8.1	2.63
June 24	14	57 - 31	169 - 26	73	0	0	0	0	4	8.6	3.09
	15	57 - 28	169 - 22.5	76	0	0	0	0	8		
	16	57 - 25	169 - 19	76	3	0	0	0	12		
	17	57 - 21	169 - 15.5	74	6	0	1	3	4		
	18	57 - 18	169 - 12	77	3	0	0	0	13		
	19	57 - 14.5	169 - 08	77	9	0	0	1	12	8.7	2.97
	20	57 - 11	169 - 05	78	12	0	3	8	3		
	21	57 - 07.5	169 - 01	79	3	0	0	1	17		
	22	57 - 04	168 - 58	80	8	0	1	2	22		
	23	57 - 01	168 - 54	81	3	0	0	1	43		
	24	56 - 57	168 - 51	85	1	0	0	0	54	9.2	2.80
June 25	25	57 - 02	168 - 35	81	1	0	0	1	13	9.3	2.98
	26	57 - 05.5	168 - 38	80	1	0	0	0	26		
	27	57 - 09	168 - 42	79	3	0	2	0	30		
	28	57 - 12	168 - 45.5	77	14	0	2	3	32		
	29	57 - 14.5	168 - 39	77	7	0	0	0	10		
	30	57 - 16.5	168 - 33	77	5	1	1	0	18		
	31	57 - 20	168 - 36	76	3	0	0	0	6	10.0	3.27
	32	57 - 18	168 - 42.5	76	2	0	0	0	28		
	33	57 - 16	168 - 49	76	3	0	1	11	48		
	34	57 - 19.5	168 - 53	76	4	0	1	1	18		
	35	57 - 23	168 - 56	74	4	0	4	1	21		
	36	57 - 26	168 - 59	74	1	0	1	1	6		
	37	57 - 30	169 - 03	73	0	0	0	0	3	9.2	3.42
June 26	38	57 - 40	167 - 00	70	0	0	0	0	8	9.0	2.09
	39	57 - 37	167 - 02	70	0	0	0	0	22		
	40	57 - 34.5	167 - 03	71	0	0	0	0	19		
	41	57 - 32	167 - 04.5	72	0	0	0	0	26		
June 27	42	57 - 29	167 - 06	73	0	0	0	0	12	9.1	3.27
	43	57 - 26	167 - 07.5	73	0	0	0	0	24		
	44	57 - 23	167 - 09	73	0	0	0	0	54		
	45	57 - 20.5	167 - 10.5	73	0	0	0	0	21		
	46	57 - 17.5	167 - 12	73	0	0	0	0	32		
	47	57 - 14	167 - 13	73	1	0	0	0	19	9.2	2.87
	48	57 - 12	167 - 15	73	0	0	0	0	21		
	49	57 - 09.5	167 - 16	74	1	0	0	0	28		
	50	57 - 06.5	167 - 17.5	75	2	0	0	1	27		
	51	57 - 03.5	167 - 18.5	75	2	0	0	0	45	9.6	3.07
	52	57 - 01	167 - 20	76	0	0	0	0	20		
June 28	53	56 - 57	166 - 45	75	0	0	0	0	7	9.3	2.88
	54	57 - 00	166 - 43.5	75	0	0	0	0	26		
	55	57 - 03	166 - 42	75	0	0	0	0	14		
	56	57 - 06	166 - 40.5	75	0	0	0	0	13		
	57	57 - 09	166 - 39	74	0	0	0	0	5		
	58	57 - 12	166 - 37.5	74	0	0	0	0	13		
	59	57 - 14.5	166 - 36	73	0	0	0	0	24		
	60	57 - 17.5	166 - 34.5	73	0	0	0	0	39	8.9	1.86
	61	57 - 20	166 - 33	72	0	0	0	0	5		
	62	57 - 23	166 - 31.5	71	0	0	0	0	10		
	63	57 - 26	166 - 30	71	0	0	0	0	10		
	64	57 - 29	166 - 28	70	0	0	0	0	16		
	65	57 - 22	166 - 27	70	0	0	0	0	7		
	66	57 - 24.5	166 - 25.5	69	0	0	0	0	13		
	67	57 - 27.5	166 - 24	68	0	0	0	0	21	8.3	1.76

1) 5 Shackles of tangle nets were set at each location.
2) Nets were left in water for a day at each location, except Stations 38, 39, 40 and 41, where nets were left in water for 2 days.

TABLE 4. Composition of catch by scouting nets, tangle nets, 1955-57.

Year	* Month	No. of Sets	No. of "tans" hauled	Total No. of crabs caught	Catch composition %				
					Males	** New-shelled males	Under-sized males	Females	Tanner crabs
1955	April	109	538.5	8,312	18.9	1.7	9.0	9.0	61.3
	May	219	1,077.5	14,798	53.1	2.6	14.3	19.0	11.1
	June	268	1,340.0	***16,563	60.2	2.2	13.5	16.9	7.2
	July	190	935.0	14,440	36.2	5.0	34.1	19.8	4.9
	August	145	717.0	8,121	13.6	5.3	11.6	7.0	62.7
	Total	**931**	**4,608.0**	**62,234**	**41.4**	**3.3**	**17.6**	**15.7**	**22.1**
1956	April	76	380.0	2,118	52.0	0.9	1.7	22.1	23.3
	May	200	998.5	10,056	51.8	0.8	1.7	34.3	11.4
	June	278	1,390.0	14,662	52.9	4.1	9.3	31.7	2.0
	July	236	1,185.0	10,917	46.5	13.4	24.0	13.4	2.7
	Total	**790**	**3,953.5**	**37,753**	**50.7**	**5.7**	**11.1**	**26.6**	**5.9**
1957	April	135	672.0	9,331	59.6	0.8	5.0	11.3	23.3
	May	488	2,490.0	40,507	67.4	2.7	9.1	13.9	6.9
	June	316	1,798.0	20,396	77.7	0.6	8.5	12.1	1.1
	July	2	10.0	102	44.1	4.9	19.6	29.4	2.0
	Total	**941**	**4,970.0**	**70,336**	**69.4**	**1.8**	**8.4**	**13.0**	**7.4**

* April 10 — Aug. 13 in 1955.
April 25 — July 29 in 1956.
April 23 — July 1 in 1957.

** Called "soft shelled male" in the Annual Reports, 1955 and 1956. In March, 1957, it was agreed between Japan and the United States to describe so-called "haikaragani" as "new-shelled crabs" in order to distinguish them from moulted crabs (soft-shelled crabs). Moulted crabs are defined as "crabs which have just moulted, having a new soft shell, and which are not able to move," and new-shelled crabs are "crabs with a hard but new shell which is free from fouling organisms, such as barnacles, and with white basipodites of legs." For catches of Japanese scouting nets another commercial category is added: namely "male crabs of legal size with poor or inadequate meat." However, criteria for the degree of fullness of meat are very inaccurate and subject to personal errors.

*** The number 16,535 in the Annual Report, 1956, is a mistake and is corrected here.

Fig. 3. Areas in which juvenile crabs were collected. (Delimited areas represent commercial tangle net grounds.)

Relation of current to distribution and dispersal of young

A total of 3,084 juvenile crabs were discovered attached to nets or seaweed when tangle nets were hauled in. Most of these juvenile crabs were smaller than 20 mm. in carapace length; however, the measurements have not been completed as yet. The areas in which the juvenile crabs were found and areas covered by tangle nets are shown in Figure 3. The areas in which many juvenile crabs were found are almost the same as those in which juvenile crabs were collected in 1956.

In addition to the collection of juvenile crabs, measurements of tidal currents, sea water sampling and plankton sampling were conducted on the fishing grounds and analysis of the data is proceeding. Bottom water temperature and depth in each tangle net ground are shown in Table 5.

TABLE 5. Bottom water temperature and depth, 1957.

Period	* Grounds	Average bottom water temperature	Average depth	No. of observations
April 27 - May 20	Near Amak Island	1.96°C.	89.5 m.	17
May 21 - May 28	Off Black Hill	2.47°C.	76.3 m.	7
May 29 - June 5	Off Kudobin Islands	3.22°C.	68.5 m.	8
June 6 - July 4	Off Port Moller	3.47°C.	73.6 m.	27

* See Fig. 1 for grounds.

Study of movements by tagging

During the 1957 fishing season, 1,897 male crabs were released with a celluloid tag attached to the muscle beneath the carapace with a wire. In order to determine the rate of loss of tags 451 crabs of the above number were tagged with an additional tag of the Peterson type attached to the carapace with a nickel pin. There have been no recoveries reported to the present time.

References:

Annual Report, 1955, International North Pacific Fisheries Commission, 1956, p. 45 - 49.

Annual Report, 1956, International North Pacific Fisheries Commission, 1957, p. 62 - 65.

Corrections:

(1) In Figure 1 (p. 62) of the Annual Report for 1956:

APRIL - MAY 25 should be corrected as APRIL 29 - MAY 25.

JULY 28 - AUGUST 2 should be corrected as JULY 23 - AUGUST 4.

(2) In Table 2 (p. 63) of the Annual Report for 1956:

1953 . . . number of tans hauled 106,438 should be corrected as 106,305.

C. REPORT ON THE INVESTIGATIONS BY THE UNITED STATES FOR THE INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION—1957

The progress in the investigations of salmon fishery in the North Pacific and the Bering Sea continues to be encouraging, and as the preliminary reports show, we can anticipate even more definitive results. The increased number of samples taken this year allows a more exact analysis of trends discovered in the first two years of investigations, and the continued exchange of information among the scientists of Canada, Japan and the United States augments the effectiveness of separate studies.

Investigations being conducted by the U. S. Fish and Wildlife Service and by the Fisheries Research Institute of the University of Washington, have fulfilled as far as possible the research assigned to the United States by the Commission. This report includes the progress made to date on these studies.

DISTRIBUTION AND RACIAL SAMPLING OF SALMON ON THE HIGH SEAS

The Schooners *Attu* and *Pioneer* were used throughout the 1957 season in the North Pacific-Bering Sea area. On 28th May the *Attu* began sampling on 175° W. at 50° N., subsequently moving north to set at 53° N. and 56° N. The red salmon catch increased northward from an average of 3.5 per shackle (4½- and 5½-inch mesh) at 53° N. to 12.5 shackle at 56° N. The *Attu* then moved eastward to determine whether the concentration of red salmon found south of the Pribilof Islands in 1956 is an annual occurrence, and if so, to obtain information on the extent of and reasons for this concentration. On June 18th at 56° N. - 170° W., the catch of reds per shackle dropped to 9.1. (In contrast, on June 20, 1956, at the same station, the catch per shackle was 78.5 reds.) Subsequent sets to the north and east showed that red salmon were not as abundant in the Pribilof area this year as they had been in 1956. Later it became apparent that they also were less abundant in the Bristol Bay fishery.

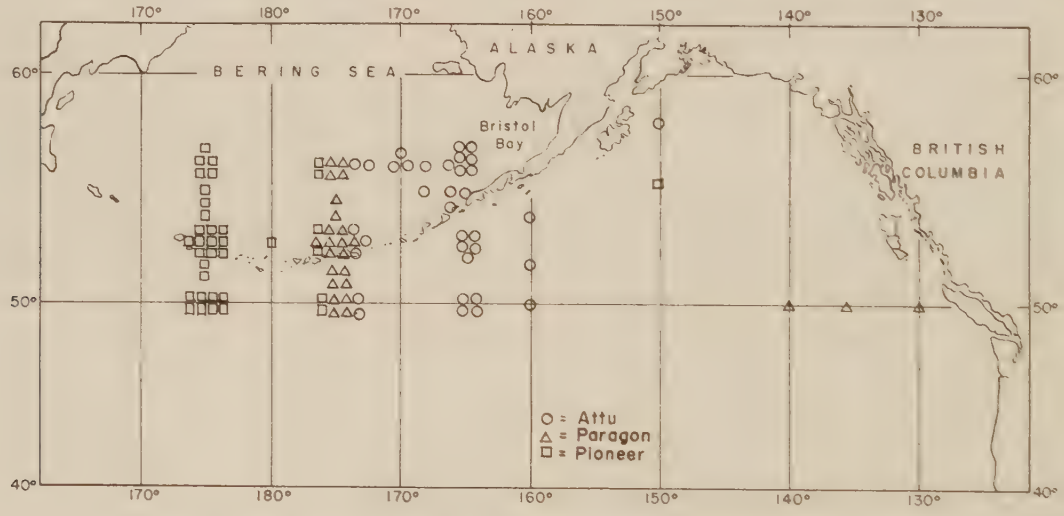

Fig. 1. Fishing stations of MV *Attu,* MV *Paragon* **and** MV *Pioneer* **during the 1957 season.**

Observations showed that the temperature of the water on the shelf area of the eastern Bering Sea was much higher this year than last, possibly causing a wider dispersion of the reds.

On June 10th the *Pioneer* initiated sampling on 175° E. near Attu Island to collect adequate racial samples, and then moved eastward to 175°W. to resample the stations previously fished by the *Attu,* returning on July 16th to 175° E.; on July 21st the *Paragon* arrived to resume the fishing on 175° W. while, for the remainder of the season, the *Attu* occupied stations on 160°W. and 165°W.

Until the end of August the three vessels fished at generally parallel positions on 175° E., 175° W., and 165° W. at primary stations 50° N., 53° N. and 56° N. and occasional secondary stations between. Tables 1, 2 and 3 show the positions of all stations and the salmon catches by species; Figure 1 plots the stations.

Figure 2 presents a preliminary plot of the distribution of resident, feeding salmon. The shaded area represents small salmon, not over 385 mm. in fork length, virtually all of which measure from 13 to 15 inches. Fish of this size, taken in spring and mid-summer, show a single ocean annulus indicating that they have resided one winter in the ocean and may be expected to remain at least one additional winter. Their distribution should, therefore, reflect a feeding phase rather than a movement from or to the spawning grounds. The plot shown in Figure 2 (neither complete nor weighted by fishing effort) serves to indicate the relative unimportance of the eastern Bering Sea as a feeding area for young resident salmon, and also shows the rather surprising difference in the distribution of young red and chum salmon.

Small chums were first found in numbers north of Attu on 175° E. early in July and later north and south of Adak on 175° W., but relatively few as far east at 165°W. Small reds were virtually limited to the area south of the Aleutians and were taken in greatest numbers south of Attu. They were most abundant in the catches in June and August in contrast to the chums which were more abundant in July. As catches in 1956 and 1957 show relatively the same distribution of small red and chum salmon, the data for both years are combined in Figure 2.

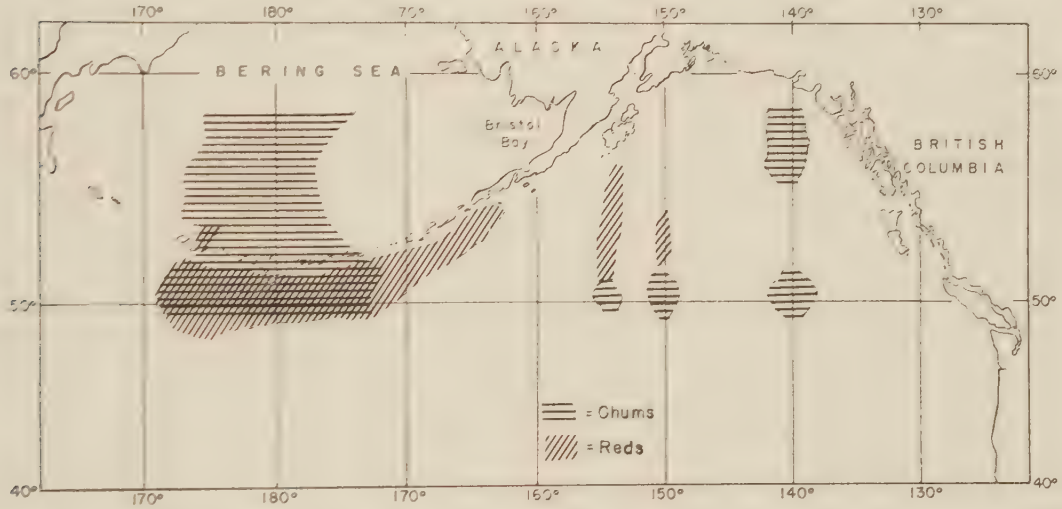

Fig. 2. Distribution of small chum and red salmon, showing areas in which fish with single ocean annulus were most abundant.

TABLE 1. Salmon catches by United States research vessels, May 28 - August 24, 1957.

PIONEER

Set No.	Date	Position Lat.	Position Long.	Temp.	Red	Chum	Silver	King	Pink	Total	Steel-head
1	June 10	50°N	175°E	5.3°C	47	103			202	352	
2	June 11	50 N	175 E	5.6	67	42			98	207	
3	June 12	50 N	175 E	6.7	94	103			150	347	
4	June 14	53 N	175 E	6.6	31	32			208	271	
5	June 20	53 N	175 E	5.7	63	56			321	440	
6	June 22	53 N	180	6.3	52	55			828	935	
7	June 29	56 N	175 W	7.6	7	57			217	281	
8	June 30	56 N	175 W	7.7	46	59			71	176	
9	July 3	53 N	175 W	7.0	3	43				46	
10	July 4	53 N	175 W	7.0	7	40			7	54	
11	July 6	50 N	175 W	8.2	2	91	9	1	1	104	5
12	July 7	50 N	175 W	8.3		111	9		1	121	
13	July 8	51 N	176 W	8.5	46	152	5	2	12	217	2
14	July 16	56 N	175 E	8.8	8	40			16	64	
15	July 19	53 N	175 E	8.2	5	312			2	319	
16	July 21	50 N	175 E	8.9	1	50	4			55	
17	July 22	50 N	175 E	9.2	11	43	47	1		102	
18	July 23	52 N	175 E	9.0	4	46	5		3	58	
19	July 24	53 N	175 E	9.8	2	203	3	1	1	210	
20	July 25	54 N	175 E	9.7	2	55		1	1	59	
21	July 26	55 N	175 E	9.9	2	42			2	46	
22	July 27	56 N	175 E	9.8	2	124	1			127	
23	July 27*	56 N	175 E	9.8	2	7			1	10	
24	July 28	56 N	175 E	9.8	6	65	2			73	
25	July 30	53 N	175 E	10.6		39	3		1	43	
26	Aug. 8	50 N	175 E	9.5	41	29	6			76	3
27	Aug. 9	50 N	175 E	9.8	30	28	2	2		62	1
28	Aug. 11	53 N	175 E	8.8	64	47			2	113	
29	Aug. 12	53 N	175 E	9.5	91	103			2	196	
30	Aug. 13	54-30 N	175 E	10.0	6	49			1	56	
31	Aug. 14	56 N	175 E	10.6	44	58				102	
32	Aug. 17	53 N	175 E	10.1	115	127	1		2	245	
33	Aug. 18	53 N	175 E	10.0	61	82			1	144	
34	Aug. 19	51-30 N	175 E	9.8	64	64	15	6	2	276	5
35	Aug. 20	50 N	175 E	10.1	98	15				113	
36	Aug. 23	51-30 N	175 E	8.95	123	163	1	2	2	291	1
37	Aug. 24	53 N	175 E	9.9	16	52	1			69	
38	Sept. 7	55 N	150 W	12.9	3	31				34	4
	TOTALS				1,391	2,818	114	16	2,155	6,494	21

* Day set.

TABLE 2. Salmon Catches by United States Research Vessels, May 28 - August 24, 1957.

M/V *ATTU*

Set No.	Date	Position Lat.	Position Long.	Temp.	Red	Chum	Silver	King	Pink	Total	Steel-head
1	May 28	50°N	175°W	5.9°C	7	34			99	140	
2	May 30	50 N	175 W	5.9	8	62			118	188	
3	May 31	50 N	175 W	5.8	6	21			252	279	
–	June 1	46 N	175 W	7.4	—	—	—	—	—	—	—
4	June 8	53 N	175 W	5.8	52	1		5	68	126	
5	June 9	53 N	175 W	5.6	58	10		5	78	151	
6	June 10	53 N	175 W	5.7	68	14		1	62	145	
7	June 15	56 N	175 W	5.8	237	14		1	61	313	
8	June 17	56 N	173 W	6.9	187	16		2	174	379	
9	June 18	56 N	170 W	7.4	116	9		1	11	137	
10	June 19	56-52N	170 W	7.0	68	1				69	
11	June 20	56 N	170 W	7.7	9	1			2	12	
12	June 21	56 N	168 W	7.9	63	6			20	89	
13	June 22	55 N	168 W	7.9	88	5			9	102	
14	June 23	56 N	166 W	9.1	19	1				20	
15	June 24	55 N	166 W	9.5	15	10			5	30	
16	July 8	56 N	165 W	10.4		2				2	
17	July 9	56 N	165 W	10.2		1				1	
18	July 10	56 N	165 W	10.6	1	27				28	
19	July 15	54 N	160 W	11.9	26	132			12	170	5
20	July 17	52 N	160 W	10.2	25	126		1		152	3
21	July 19	50 N	160 W	10.3	6	93	3	1	1	104	3
22	July 21	50 N	165 W	10.0	3	55	1	1		60	2
23	July 24	53 N	165 W	11.0	123	252	4		2	381	10
24	July 25	53-40 N	165 W	10.1	15	35	2		29	81	
25	July 27	56 N	165 W	10.1	3	2	8		1	14	
26	July 27*	56 N	165 W	10.2		6				6	
27	July 28	56 N	165 W	10.2	1					1	
28	July 30	53 N	165 W	11.5	19	37	5		3	64	
29	July 31	53 N	165 W	11.8	25	31	12		2	70	6
30	Aug. 9	50 N	165 W	11.4	17	162				179	4
31	Aug. 11	53 N	165 W	11.9	2	63	2		2	69	5
32	Aug. 14	54-30 N	166 W	10.4-9.9	1		1			2	
33	Aug. 15	55 N	165 W	9.5-8.3	5	2			2	9	
34	Aug. 16-18	53 N	165 W	12.8-12.6	14	247	8			269	15
35	Aug. 20	50 N	165 W	12.4	7	35				42	
36	Aug. 21	50 N	165 W	12.5	2	6				8	
37	Sept. 8	58 N	140 W	13.8		11				11	
	TOTALS				1,296	1,530	46	18	1,013	3,903	53

* Day set.

TABLE 3. Salmon Catches by United States Research Vessels, May 28 - August 24, 1957.

M/V PARAGON

Set No.	Date	Position Lat.	Position Long.	Temp.	Red	Chum	Silver	King	Pink	Total	Steelhead
1	July 21	50°N	175°W	9.9°C	4	19	8			31	1
2	July 22	50 N	175 W	10.8	14	57	10	2		83	3
3	July 24	53 N	175 W	8.6	1	21	2		1	25	
4	July 25	53 N	175 W	8.6	1	1				2	
5	July 27	56 N	175 W	9.3		3				3	
6	July 27*	56 N	175 W	9.3	1	2				3	
7	July 28	56 N	175 W	9.4	2	4				6	
8	July 30	53 N	175 W	9.2	1	10	1		1	13	
9	July 31	53 N	175 W	9.3		3			1	4	
10	Aug. 1	53 N	175 W	9.7	1	4		1		6	
11	Aug. 6	51-30 N	175 W	10.4	50	77	9	1	7	144	3
12	Aug. 7	51 N	175 W	10.1	148	5	3			156	2
13	Aug. 8	50 N	175 W	9.9	82	62	4	15		163	5
14	Aug. 9	50 N	175 W	11.0	165	51	1	4	1	222	2
15	Aug. 12	53 N	175 W	9.4	2	1				3	
16	Aug. 13	54-30 N	175 W	10.2		5				5	
17	Aug. 14	56 N	175 W	10.1	4	18				22	
18	Aug. 16	54 N	175 W	9.8		1				1	
19	Aug. 17	53 N	175 W	10.1	5	83				88	
20	Aug. 18	53 N	175 W	10.4	1	39				40	
21	Aug. 20	50 N	175 W	11.6	81	27				108	1
22	Aug. 21	50 N	175 W	12.1	85	14		1		100	1
23	Aug. 22	51 N	175 W	11.1	119	27				146	7
24	Aug. 23	51-30 N	175 W	11.4	53	175	4	1		233	5
25	Sept. 8	50 N	140 W	13.8	9 absence					0	
26	Sept. 10	50 N	135 W	14.6						0	
27	Sept. 12	50 N	130 W	15.7						0	
	TOTALS:	*Paragon*			820	709	42	25	11	1,607	30
		Attu			1,296	1,530	46	18	1,013	3,903	53
		Pioneer			1,391	2,818	114	16	2,155	6,494	21
	GRAND TOTALS				3,507	5,507	202	59	3,179	12,004	104

* Day set.

Pink salmon were of minor importance in the 1956 catches of the *Mitkof, Tordenskjold, Paragon, Celtic,* and *John N. Cobb,* the total for the season being 484, of which 60% were taken by the *Celtic* in the northern gulf of Alaska. This year the *Pioneer, Attu* and *Paragon* took 3,180 pinks. At 53° N. - 180° the *Pioneer* captured 829 in one set, and a total for the season of 2,155; the *Attu* captured 1,014, most on or near the provisional treaty line.

This year Pacific Salmon Investigations established an oceanographic unit integral to its fishing operation, thus increasing the volume of oceanographic sampling and its subsequent value to the results of salmon sampling. The research vessels conducted extensive oceanographic sampling on each fishing station and at other designated hydrographic stations to supplement the biological data. The routine observations included plankton hauls, bathythermograph lowerings, Nansen bottle casts, and night light stations. The vessels also released 480 drift bottles at various points in the Aleutian Island area to aid in the determination of water movements.

The results of the 1956 - 1957 oceanographic observations have contributed to a clearer understanding of the salmon environment. The oceanic areas in which salmon are caught by gill net in the spring and summer are generally characterized by the presence of cold water (1° - 4° C.) at a depth of approximately 100 meters. This water is believed to be the result of winter cooling as the temperatures are similar to those existing in the winter at the sea surface. Prevented from mixing to a greater depth by an underlying, sharp, relatively permanent salinity gradient, and warmed from above by insolation in the spring and summer, this stratum of cold water delineates a very shallow surface layer which has a high dissolved oxygen content.

A number of conclusions can be inferred from the existence of this cold stratum. The sharp temperature gradients could force salmon into the surface waters. Then, too, the stratum may permit salmon to reach the preferred low temperatures at will because of their shallow depth. On the other hand, these temperatures may reflect those of the winter environment inhabited by salmon. Figure 3 shows the presence of salmon above this cold stratum at 155° W. in 1956. The region south of 49° N. where no salmon were caught cannot be identified by surface temperatures, but is clearly marked by the southward limit of the cold stratum indicated by the vertical isotherms.

The minimum temperature in this stratum varies geographically and annually and could affect the concentrations of salmon in the area.

The relation between the annual changes in water properties on the shelf and the timing and migration pattern of Bristol Bay salmon is becoming more clearly defined. Figure 4 indicates a possible relation between water temperature and red salmon catch in the Bering Sea along 170° W. In June, 1956, when the water temperatures over the shelf were 3° C. or less, the vessels caught large numbers of red salmon in the warmer water off the shelf; however, in 1957, when the surface water over the shelf was much warmer, the vessels caught considerably fewer fish at the surface off the shelf. The cold surface water temperatures in 1956 may have imposed a barrier that contributed to the concentration of red salmon off the shelf.

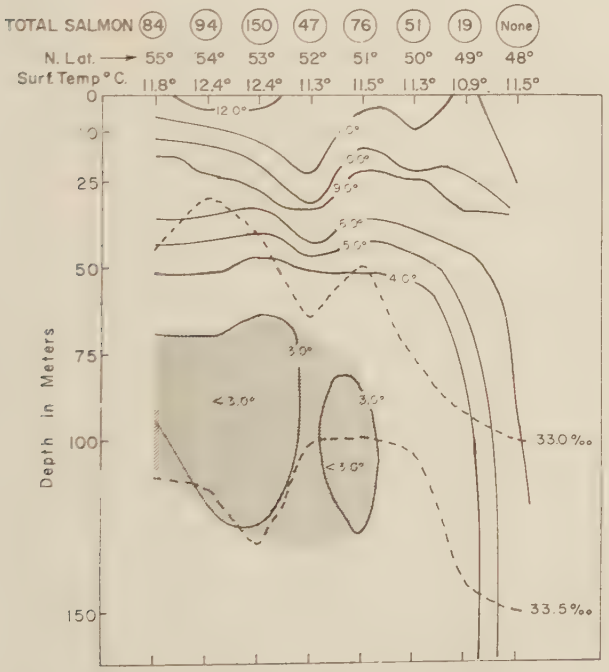

Fig. 3. Vertical section along 155° W. (MV *Celtic*, **16 - 27 August, 1956).**

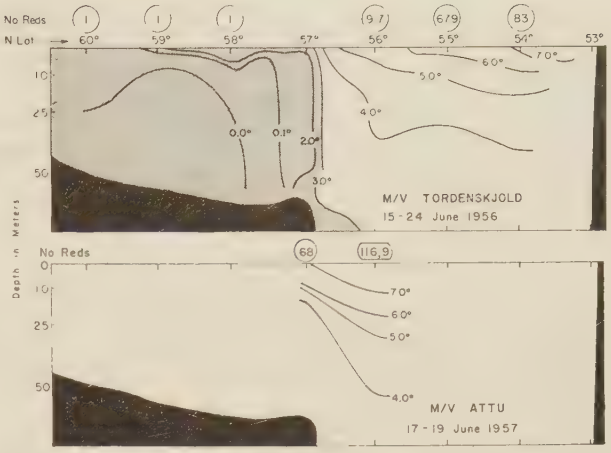

Fig. 4. Vertical sections along 170° W.

We are investigating the relationship of salinity, other chemical constituants, and plankton to salmon environment, as well as monthly and annual changes of these water properties.

RACIAL STUDIES, 1955 - 1957

Collection of Samples

From 1955 to 1957 increasingly larger numbers of salmon racial samples have been collected for North Pacific Treaty studies on the identification of stocks. The various investigators, working to separate racially the Asian and North American salmon stocks, are processing and analysing these field collections consisting of whole frozen salmon, salmon measurements and scales, salmon blood samples, and young downstream-migrant salmon. The means of intensive approach to this objective are many; United States scientists are placing special emphasis on scale characteristics, parasite content, blood characteristics, and meristic counts of salmon.

Observers have concentrated sampling effort on chum, pink and red salmon from the important areas in which these three species are available, and which encompass their full geographic range (except for inshore Siberia). Samples were collected from the Columbia River northward to Kotzebue and westward to Attu; from the high seas research vessels of the United States, Japan and Canada; from the Japanese mothership operations in the North Pacific Ocean and Okhotsk Sea; and from Japan proper.

During the 1957 season, more than 29,000 whole salmon were collected and frozen (a small number salted) for the racial studies, including about 12,000 reds, 10,000 chums, and

7,000 pinks (Table 4). Of this total, about 6,600 were obtained by Japan, nearly 14,000 by United States and Canadian research vessels, and 9,000 from the major inshore areas of Alaska, Canada and the Northwest States. A portion of these samples will be transferred to Canada and Japan in accordance with requests from scientists of those countries.

Additional collections in 1957 consisted of about 50,000 salmon scales and field measurements (greatly augmented by large collections made by the Fisheries Research Institute, University of Washington), 1,700 fresh blood samples and 4,000 downstream-migrant salmon. It is noteworthy that the shipping by air of iced blood samples from remote areas to Seattle has been successful.

TABLE 4. Numbers of whole salmon collected for North Pacific racial studies in 1957.

	Reds	Chums	Pinks	Total
Aleutian Islands				
Attu	311	—	249	560
Alaska Peninsula				
King Cove	235	135	135	505
Chignik	235	—	—	235
Bristol Bay				
Ugashik	216	—	—	216
Egegik	216	—	—	216
Naknek	577	—	—	577
Kvichak	220	—	—	220
Nushagak	200	—	—	200
Northwest Alaska				
Kuskokwim	134	107	—	241
Yukon	—	260	10	270
North of Yukon	77	135	135	347
Cook Inlet				
Seldovia	—	135	135	270
Anchorage	86	—	—	86
Kodiak Island				
Karluk	480	—	—	480
Red River	235	—	—	235
Larsen Bay	—	135	135	270
Prince William Sound				
Copper River	235	—	—	235
Prince William Sound	—	135	136	271
Yakutat				
Yakutat	235	135	135	505
Southeast Alaska				
Petersburg	255	145	148	548
Ketchikan	259	279	207	745
British Columbia				
Northern	297	250	200	747
Central	90	130	100	320
Southern	200	130	100	430
Washington and Oregon				
Puget Sound	—	149	135	284
Columbia River	135	30	—	165
Tillamook	—	30	—	30
Japan-Hokkaido				
Local Streams	—	135	135	270
Offshore Fishery	—	270	270	540
Japanese Motherships				
Okhotsk Sea	705	405	405	1,515
North Pacific Ocean	1,332	765	851	2,948
Japanese Research Vessels	662	353	302	1,317
U. S. Research Vessels	3,449	5,003	3,180	11,632
Canadian Research Vessels	711	1,087	172	1,970
TOTAL	11,787	10,338	7,275	29,400

During the three years of collection, 1955 - 1957, a total of 60,000 whole frozen salmon has been collected from all areas, including 26,000 reds (Table 5), 21,000 chums (Table 6) and 13,000 pinks (Table 7), plus small numbers of kings and silvers. In 1955, collections totalled 9,000 whole salmon (excluding kings and silvers). In 1956 the collections were increased to 22,000 salmon in order to furnish the investigators adequate representative samples. In 1957 the numbers were increased further to 29,000 salmon, due to the increased success of fishing at key sampling stations by the U. S. research vessels and to the additional samples from the Hokkaido offshore fishery and the Canadian research vessels.

TABLE 5. Numbers of whole RED salmon collected during the three years, 1955 - 1957.

	1955	1956	1957	Total
Offshore Areas				
United States Research Vessels	459	3,506	3,449	7,414
Japanese Motherships				
Okhotsk Sea	125	671	705	1,501
North Pacific	399	1,512	1,332	3,243
Japanese Research Vessels				
North Pacific	—	116	662	778
Canadian Research Vessels	—	—	711	711
Inshore Areas				
Aleutian Islands	70	864	311	1,245
Alaska Peninsula	167	350	470	987
Bristol Bay	365	1,079	1,429	2,873
Northwest Alaska	8	77	211	296
Cook Inlet	200	220	86	506
Kodiak Island	360	655	715	1,730
Copper River	200	220	235	655
Yakutat	—	117	235	352
Southeast Alaska	275	450	514	1,239
British Columbia	584	1,039	587	2,210
Washington and Oregon	75	537	135	747
TOTAL	3,287	11,413	11,787	26,487

TABLE 6. Numbers of whole CHUM salmon collected during the three years, 1955 - 1957.

	1955	1956	1957	Total
Offshore Areas				
United States Research Vessels	1,619	3,550	5,003	10,172
Japanese Motherships				
Okhotsk Sea	100	342	405	847
North Pacific	425	632	765	1,822
Japanese Research Vessels				
North Pacific	—	148	353	501
Japan — Offshore Hokkaido	—	—	270	270
Canadian Research Vessels	—	—	1,087	1,087
Inshore Areas				
Aleutian Islands	—	9	—	9
Alaska Peninsula	140	200	135	475
Bristol Bay	—	128	—	128
Northwest Alaska	73	475	502	1,050
Cook Inlet	75	125	135	335
Kodiak Island	—	—	135	135
Prince William Sound	—	—	135	135
Yakutat	—	125	135	260
Southeast Alaska	385	597	424	1,406
British Columbia	312	562	510	1,384
Washington and Oregon	48	170	209	427
Japan - Hokkaido Streams	—	50	135	185
TOTAL	3,177	7,113	10,338	20,628

TABLE 7. Numbers of whole PINK salmon collected during the three years, 1955 - 1957.

	1955	1956	1957	Total
Offshore Areas				
United States Research Vessels	720	383	3,180	4,283
Japanese Motherships				
Okhotsk Sea	125	371	405	901
North Pacific	385	267	851	1,503
Japanese Research Vessels	—	119	302	421
Japan — Offshore Hokkaido	—	—	270	270
Canadian Research Vessels	—	—	172	172
Inshore Areas				
Aleutian Islands	157	932	249	1,338
Alaska Peninsula	130	200	135	465
Bristol Bay	—	14	—	14
Northwest Alaska	12	119	145	276
Cook Inlet	50	125	135	310
Kodiak Island	100	125	135	360
Prince William Sound	—	—	136	136
Yakutat	—	85	135	220
Southeast Alaska	379	270	355	1,004
British Columbia	414	361	400	1,175
Washington and Oregon	100	—	135	235
Japan - Hokkaido Streams	—	50	135	185
TOTAL	2,572	3,421	7,275	13,268

Study of Scales

Biologists completed the routine scale readings of the 1956 red salmon samples on July 31, 1957, and have since been analyzing the various scale characters. Most of the characters have been tabulated into final form, and preliminary comparisons have been made between localities and with comparable scale features of the 1955 samples. Considerable additional study and work, however, will be required to analyze completely the data for this season.

A few months ago Dr. Krogius (1) of Russia sent the Fisheries Research Board of Canada samples of red salmon scales taken in August, 1956, from 100 fish each from the Bolshaya, Ozernaya and Kamchatka Rivers of the Kamchatka Peninsula. Copies of these scales were generously sent to scientists of Japan and the United States.

The preliminary results show that relative to the timing of the Japanese catches and the collections of scales, most characters indicate a similarity between the scales from the Bolshaya and Ozernaya Rivers and those taken by the Japanese fleet in the Okhotsk Sea and off the eastern Kamchatka coast. In the sample from the Kamchatka River, some of the fish resemble those taken by the Japanese fishery off the east coast of Kamchatka, but the bulk of them do not. This indicates that the Japanese fleet tapped Kamchatka River stocks either earlier or later than the August sample or, more likely, that other rivers than the Kamchatka supplied the bulk of these fish.

Additional study is in progress to evaluate more completely these samples which are extremely valuable as the only samples of local red salmon stocks from Asian streams which we have available for comparison with the Japanese catches. Considering the important information which can be obtained from scale samples alone, and the relative ease of collection and shipment, we should make every effort to obtain additional and more extensive samples from Asian sources.

Comparisons of numerous scale characters by locality for our 1956 samples indicate that the fish taken in the Okhotsk Sea and off the east coast of Kamchatka are essentially different from fish taken in our mainland areas. As in the 1955 samples, the differences are small when compared to some of the Aleutian Island or Bristol Bay areas, but greater when dealing with areas farther south and east. In some characters the difference is opposite to the difference in other characters; nevertheless, in total the variations are enough to distinguish the groups.

Fish from samples taken from the high seas by Japanese and United States vessels have been identified with their continent of origin. The results of these determinations are shown in Figure 5.

(1) Dr. F. V. Krogius of the Kamchatka Branch of TINRO, Petropavlovak.

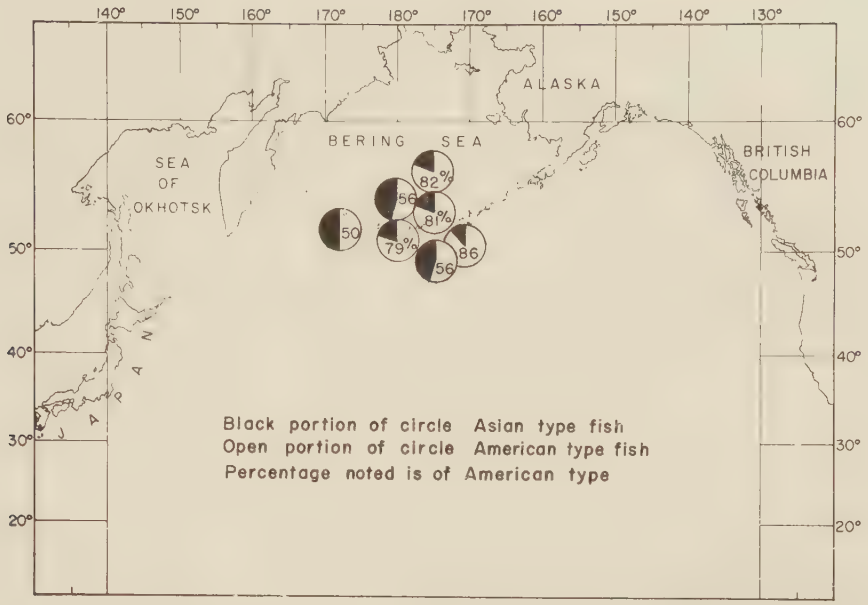

Fig. 5. Distribution of Asian and American type red salmon during 1956 fishing season as determined by scales.

A study is under way to describe the scale characters in general enough terms so that the determination of racial origins may be made before the season's data are completely processed. Scales from a test group of fish from the Bristol Bay 1956 collections were analyzed for racial origin using 1955 reference data and all were correctly identified. A test with similar results was performed on a sample of 1957 scales using 1956 reference data. While variations exist in year classes, certain characters probably are consistent from year to year. Our present study should indicate the extent of this racial similarity.

Parasites of Chum Salmon

The application of parasitological methods to the problem of distinction between continental races of salmon assumes the existence of consistent and measurable differences, either qualitative or quantitative, in the parasite fauna of the respective stocks. The search for such differences has been in progress since late 1955 when representative samples of Asian and North American stocks of chum salmon first became available.

Examination of large series of samples has revealed the presence of over thirty species of parasites. The majority of species encountered showed either generalized distribution throughout the study area, or such irregular appearance as to preclude their consideration in a practical sampling program. Five among the thirty, however, have repeatedly shown great abundance in samples taken west of the provisional absention line. Among the five, three species have been selected for intensive study as potential indices of racial likeness. In order of importance these are (1) the larval nematode *Anisakis* sp., (2) the acanthocephalan species *Echinorhynchus gadi*, and (3) the post larval acanthocephalan *Bolbosoma* sp. The present report is mainly concerned with observations on *Anisakis,* since that species in particular is the key organism in a system of classification under development.

The 1955 sample consisted of approximately 25 samples each from 14 areas ranging from the Okhotsk Sea to the North American coast. In 1956, field observers increased the number of samples to 30 each from a total of 23 areas covering approximately the same range.

Each of the three parasites discussed occurs more frequently and more abundantly in samples taken in western than in eastern Pacific waters. After two years of observation, it appears safe to conclude that prevailing ecological conditions in the western Pacific range of chum salmon are more optimal for these parasites than those prevailing in eastern Pacific waters. It follows, therefore, that the relative abundance of these organisms in representative samples of salmon will be in direct proportion to the risk of infection inherent in and about the waters of continental origin. Generally speaking, ocean salmon samples showing "high" rates of infection with any of these parasites are probably Asian in origin, but

samples showing "low" infection rates are probably North American in origin. Attempts to reduce this generalization to an objective working method will require an accurate annual estimate of the prevailing frequency of occurrence of these parasite "marks" in known Asian and American stocks. From such estimates, it will be possible to establish an Asian standard and an American standard with which high seas samples can be compared. Such estimates, of course, must be drawn from large and carefully controlled samples.

The distribution of *Anisakis* in 1956 chum salmon samples is graphically presented in Figures 6 and 7. Figure 6 shows the mean level of

TABLE 8. Composition of Sample (Age IV Chum Salmon)

Area No.	Locality	Sample Size
1	Hokkaido	14
2	Okhotsk Sea	8
3	159°E 49°N	27
4	163°E 53°N	16
5	166°E 47°N	25
6	170°E 52°N	6
7 *	175°E 50°N (June)	13
8 *	175°E 50°N (Aug.)	9
9	180° 50°N	12
10	175°W 50°N	10
11 *	170°W 50°N	14
12 *	170°W 55°N	22
13	165°W 49°N	20
14	King Cove	25
15	160°W 52°N	9
16	Bristol Bay	22
17	150°W 56°N	10
18	135°W 54°N	9
19	Petersburg	25
20	Ketchikan	26
21	Fitzhugh Sound	18
22 *	Fraser River	19
23 *	Vashon Island	24

* Data combined in Figure 7.

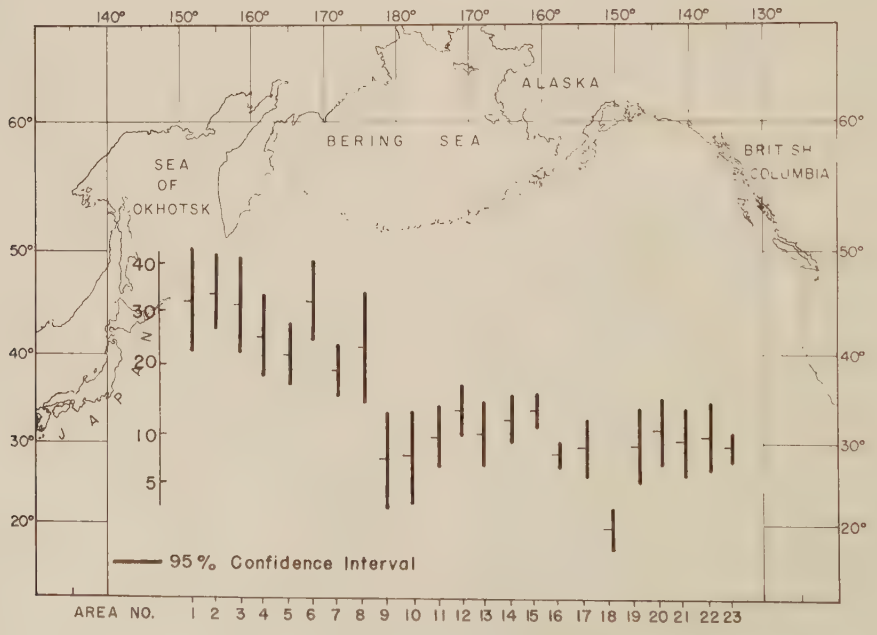

Fig. 6. Distribution of *Anisakis* by area (1956). (Mean level of infection).

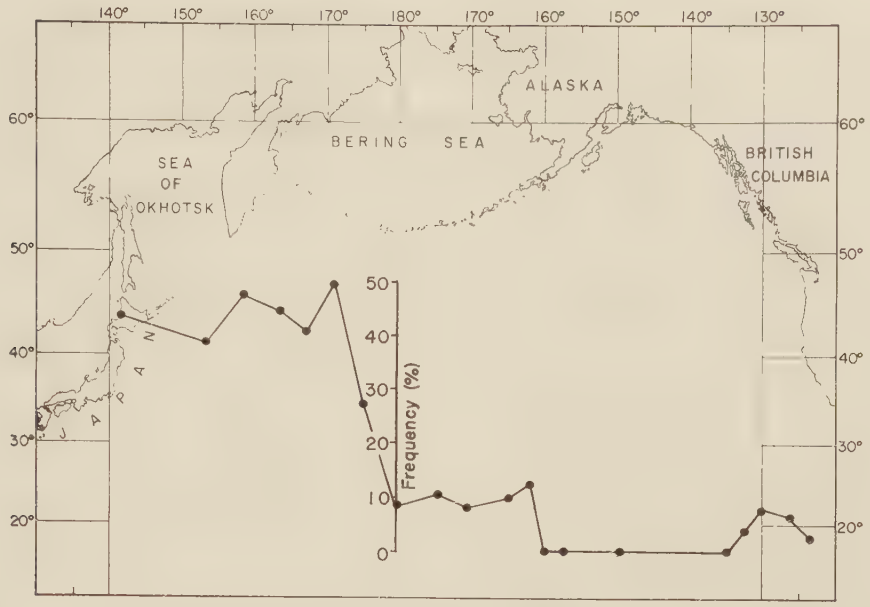

Fig. 7. Incidence of *Anisakis* infection. (Intensity ≥ 25).

Anisakis infection in samples according to longitude. Figure 7 shows the incidence (percent of sample) of fish in samples having 25 or more parasites. (Related data concerning the individual samples are given in Table 8.) The data used in Figures 6 and 7 are based on observed numbers of *Anisakis* recovered from an aliquot portion of the musculature plus the number observed on the visceral organs. It was observed in 1955 studies that the parasites are bilaterally distributed with the greater majority (ca. 95%) occurring in the ventral musculature. For enumerative purposes, therefore, examination of samples has been limited to the musculature of the left side only, plus visceral organs. In chum salmon, at least, the number of worms occurring on the visceral organs is negligible when compared with the total number of worms from the entire fish. Thus, a reasonable estimate of total infection in any fish may be obtained by simply doubling the observed number from either side.

Laboratory technicians intend to process 1957 samples by peptic digestion. With respect to manpower efficiency, it is estimated that a single operator can sample four times as many fish in unit time as with the dissection method. It is planned to further explore enzymatic digestion with a view to recovery of the intestinal parasites *Bolbosoma* and *Echinorhynchus*. These parasites are also endowed with a resistant cuticularized exoskeleton which may lend them to recovery by digestion techniques as readily as *Anisakis*. There remains the problem of digestion of the intestinal tract which is resistant to pepsin and other animal proteolytic enzymes. Solution to the problem will be sought in the use of plant proteolytic enzymes such as bromelin, ficin, papain, and others.

The accumulated data from the parasitology program have provided, we believe, an excellent synoptic picture of the qualitative nature of parasitism in chum salmon. When considered quantitatively, however, it is apparent that the total sample size (ca. 1200) can only reveal basic trends in the distribution of asserted "tracer" parasites. With this understanding, we have concluded that the parasites discussed in this report display the necessary qualifications for use in an applied program.

Assuming adequacy of the data, selected samples have been used for approximation of the hypothetical standard rates of infection. Application of these rates in proportion formulations has provided estimates of relative abundance of "Asian" and "American" fish in various samples which agree favorably with subjective knowledge of the respective samples. Examination of the combination frequencies of *Anisakis, Bolbosoma,* and *Echinorhynchus* will contribute to the identification of individual fish with their continent of origin.

We believe it timely to initiate an intensive sampling effort designed to verify these findings and further test the method. Fortunately, these methods and the nature of the parasites involved lend themselves to the economical use of samples. It will be possible and desirable to re-use the samples provided to other units of the racial study group. Critical analysis of the same samples by two or more methods will doubtless provide extremely useful information.

Differences in Blood Types

In the summer of 1956 the biochemists were able to demonstrate statistically significant serological differences between populations of fish for the first time. Consistent quantitative differences in the strength of agglutination of the red cells from individual red salmon were demonstrated. Expressing the results of a standardized test in terms of a score, they found that 86% of Bristol Bay red salmon samples had scores less than 3.5 and that 83% of Columbia River red salmon samples had scores greater than 3.5.

In subsequent experiments they tested somewhat larger samples from these populations in the same way and repeated making the distinction with considerable precision. This year 92% of Bristol Bay red salmon tested had scores less than 3.5 and 79% of Columbia River red salmon tested had scores greater than 3.5. The results of these tests for the past two summers are presented in Figure 8. This test is not particularly applicable to distinguishing between Asian and American stocks at the present time; however, evidence can be obtained with it, pertaining to fundamental questions about the stability of the antigenic composition of stocks from year to year. Evidence bearing on these questions must be available in order rationally to apply serological techniques to any salmon population problem.

More recent experiments involving the technique known as agar gel diffusion have demonstrated that at least three antigens vary in their occurrence in red salmon serum samples. In 1955, ten of eleven samples from Bristol Bay possessed antigens not present in eight samples from the Okhotsk Sea. In 1956, of 129 samples from Alaska, 125 were found to possess one or

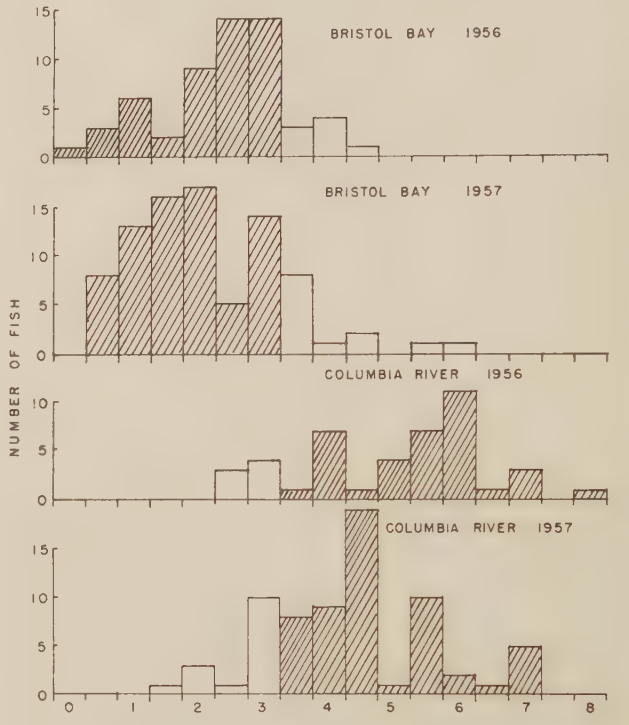

Fig. 8. Agglutination score with serum WP 4 (1956 & 1957 samples).

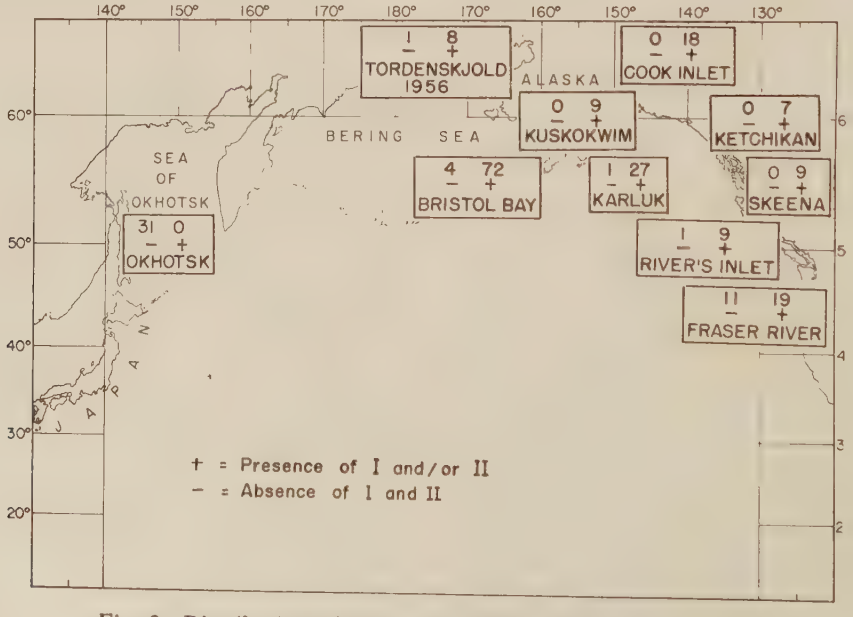

Fig. 9. Distribution of Antigens I & II (1955 & 1956 data).

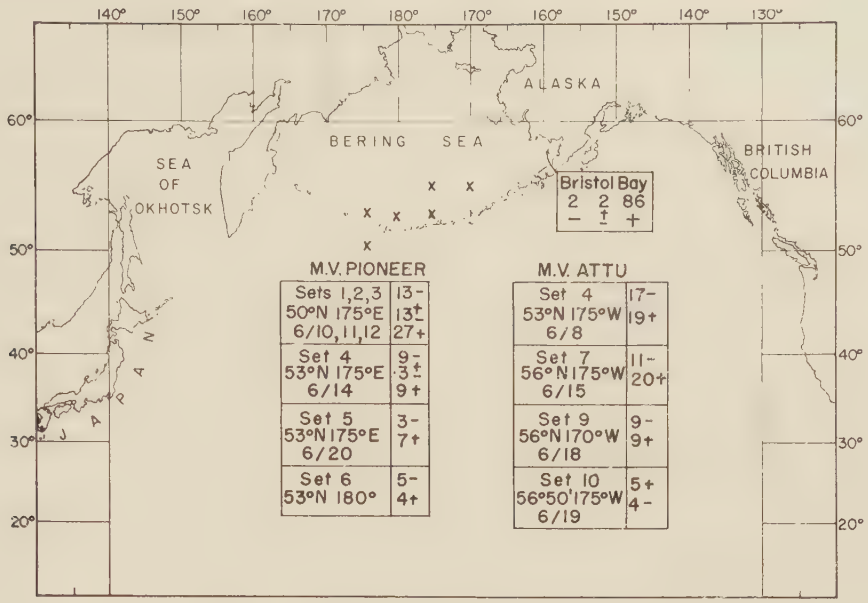

Fig. 10. Occurrence of Antigens I and II, 1957.

both of these characters called Antigens I and II although none of 23 samples from the Okhotsk Sea possessed them. Of nine samples collected by the M/V *Tordenskjold* in 1956 in the eastern Bering Sea (54° - 60° N., 160° - 170° W.), eight were scored positive for these characters and would thus be classified as American fish. The 1955 and 1956 results are combined in Figure 9. In the 1957 season an additional 90 samples from Bistol Bay were tested and 86 were found to be positive for one or both of Antigens I and II. The early samples taken by the M/V *Pioneer* and the M/V *Attu* have also been tested; the results are shown in Figure 10.

Although most of the samples taken on the high seas were relatively small in number, the most plausible explanation for their composition is the widespread intermingling of the Asiatic and American stocks of red salmon in the Aleutian area with a considerable proportion of American fish present as far west as any area where blood samples were taken (175° E.).

Counts of Body Structures

Analysis of meristic data is producing a significant contribution to the differentiation between salmon stocks. To date about 7,600 red salmon and 2,700 pink salmon have been examined. The numbers of specimens and the sampling areas for 1956 are shown in Table 9 and Figure 11.

Table 10 shows the characters used in analyses of 1955 and 1956 red salmon collections. Number of circuli to the first winter zone was replaced by the number of caudal vertebrae and gill rakers since the former was found to be related to the number of years red salmon spend in fresh water.

In general we can find no difference in meristic characters among brood years in principal continental samples. The relative morphological difference between areas was found to be very similar to the relationship established from analysis of data obtained from the 1955 collection. This stability in meristic characters lends encouragement to our hope of substantially reducing sampling effort in escapement areas of North America.

In 1956 for the first time samples from the high seas were adequate in size and number for comparison with continental samples. All high seas samples examined from the Aleutian and Kommandorski Island area most closely resembled either Bristol Bay or Okhotsk Sea red salmon. Figure 12 shows the morphological relationship of the high seas samples to these areas. Samples taken west of 170° E. very closely resemble Okhotsk Sea red salmon. Between 170° E. and 175° E. an inflection occurs and, in general, samples taken to the eastward are quite dissimilar to Okhotsk Sea reds. The morphological relationship of the same sample with respect to Bristol Bay shows the converse situation as samples from the easternmost stations very closely resemble Bristol Bay red salmon. This similarity persists in red salmon taken as far west as 172° E.

TABLE 9. List of 1956 Red Salmon Sampling Areas Used in Distance Function Analysis.

Number	Name of Area	Number of Fish
1	Naknek Weir	191
2	Egegik Weir	204
3	Ugashik Weir	196
4	Wood River	195
5	Kvichak River	199
6	*Okhotsk Sea (A)	142
7	(B)	198
8	(C)	180
9	(D)	70
10	*Eastern Kamchatka (A)	175
11	(B)	175
12	(C)	174
13	*Western Aleutian (A)	49
14	(B)	106
15	(C)	81
16	(D)	103
17	(E)	103
18	(F)	174
19	*Northern Aleutian	206
20	Attu Island (A)	315
21	(B)	43
22	Adak Island	234
23	Unalaska Island	116
24	King Cove	153
25	Chignik Lagoon	96
26	Kodiak Island: Karluk Weir (A)	200
27	" " (B)	200
28	Red River (C)	193
29	Anchorage: Fish Creek Weir (A)	162
30	Cottonwood Creek Weir (B)	30
31	Copper River	220
32	Ketchikan	198
33	Petersburg	198
34	Yakutat	84
35	Fraser River (Gulf of Georgia)	204
36	Namu	54
37	Rivers Inlet (A)	197
38	(B) (Owikeno Lake)	53
39	Skeena River	198
40	Nass River	98
41	Teller	47
42	M/V Mitkof (High Seas) (A)	181
43	(B)	95
44	(C)	84
45	(D)	109
46	M/V Tordenskjold (High Seas)	314
		6,997

* Japanese mothership samples.

TABLE 10. List of characters used in the 1956 analysis of 1955 red salmon samples, and in the 1957 analysis of 1956 red salmon samples.

	1956 Analysis	1957 Analysis
Number of scales along lateral line	X	X
Position of 1st complete haemal arch	X	X
Total number of gill rakers on 1st left gill arch	X	X
Number of branchiostegals on left side of head	X	X
Number of fin rays in left pectoral fin	X	X
Number of fin rays in anal fin	X	X
Number of circuli to 2nd winter zone	X	
Number of caudal vertebra		X
Number of gill rakers on ventral arm of 1st left gill arch		X

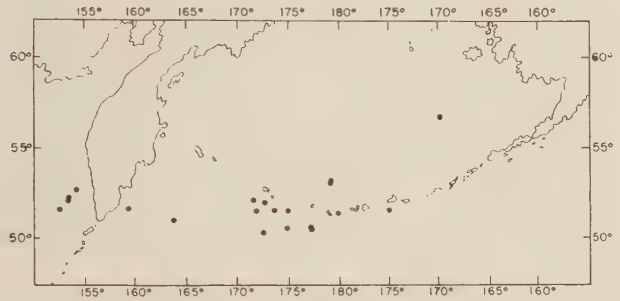

Fig. 11. Location of 1956 high seas samples.

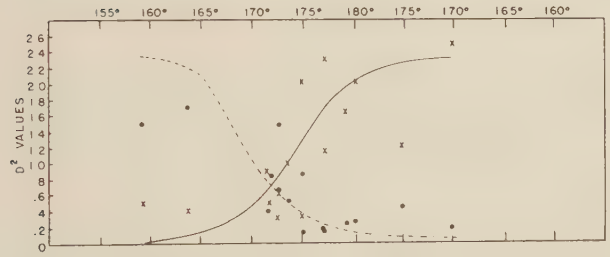

Fig. 12. Relative similarity of high seas samples to Okhotsk Sea (—x) and Bristol Bay (- - - •) samples.

Summary of Racial Studies

Within the past three years of the Commission's program, the United States has concentrated effort on various experiments to develop methods of separating the stocks of North American and Asian salmon found in the Central North Pacific. In order to evaluate the progress of the studies to date, to help in planning the future program, and to guide the Commission in its deliberations, the results of the examination of samples of red salmon from the high seas are given in Figure 13. Identification of North American or Asian red salmon is based upon analysis by three independent methods for the years 1955, 1956 and 1957, and indicate that 90% of the catches of salmon east of 175° E. are predominantly of North American origin.

The data show variability probably attributable in part to the expected misclassification in areas of overlap between characters. This shows up clearly when we compare the results of the different methods of analysis on the same sample of fish. Differences for 1955, 1956 and 1957 range from 0 to 38.2%, most of the differences, however, falling within a 15% range.

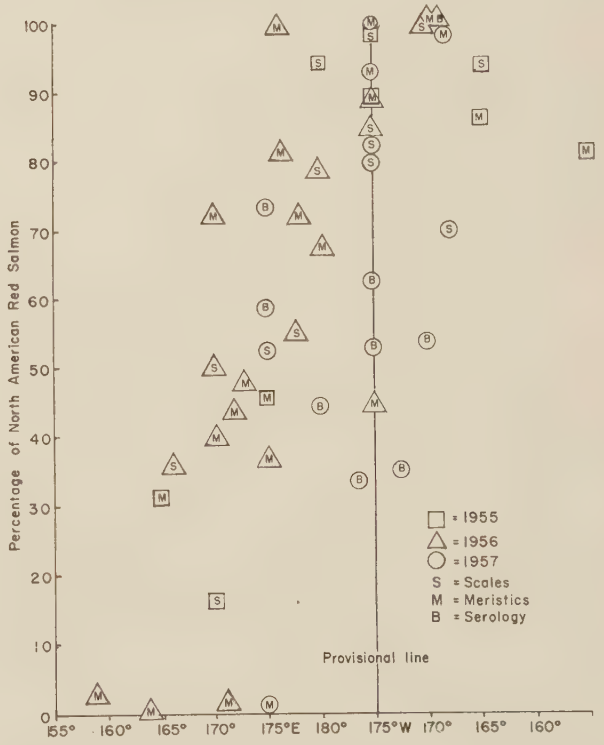
Percentage of North American Red Salmon
155° 160° 165° 170° 175°E 180° 175°W 170° 165° 160°
Provisional line
□ = 1955
△ = 1956
○ = 1957
S = Scales
M = Meristics
B = Serology

Fig. 13. Distribution of North American red salmon from all samples.

The problems of sampling now become most important. The area, comprehensively covered along the entire geographical range for red salmon in North America, is adequate for the study. From Asia, however, adequate samples are available only from the Ozernaya-Bolshaya area of the Okhotsk Sea. About 100 scales from the very important Kamchatka River provide some basis for distinguishing this group of red salmon in the high seas catches. Missing, but of importance, are samples from the northern Asian streams, such as in the Olyutorski area. Samples from the Japanse Olyutorski fleet, and perhaps the research vessels operating north of 56° N., would partially fill this need.

In the meantime we are paying particular attention to the development of methods of analysis to overcome the present lack of Asian samples. The relationships found in the model developed from meristic studies may provide a basis for interpreting the data from the present incomplete distribution of samples.

STUDY OF MOVEMENTS BY TAGGING

For the 1957 field work, the Fisheries Research Institute chartered the purse seine vessels *California Rose* (78′), *Commander* (81′), and *Renown* (85′). The *Renown* left Seattle May 6; the *California Rose* and the *Commander* May 16. All three vessels returned to Seattle September 15.

All vessels used purse seines in 1957, since this gear proved so satisfactory during 1956. Special seines of small-meshed material were built, as the 3½-inch and especially the 4½-inch material used last year permitted gilling of and injury to the smaller salmon. Details of the seines used were as follows:

1. For the *Commander* and the *Renown*, entirely new seines were hung measuring 400 fathoms long and 7½ strips deep (750 meshes). The upper four strips were of 3-inch mesh, the lower three strips 3½-inch mesh, and the bunt of knotless synthetic material with 2½-inch mesh. Standard salmon web was used for the ½ strip along the lead line. All material in the seven main strips was cotton, except for that on the *Commander*; Dyak synthetic was tried in the uppermost strip to compare synthetic and cotton. The Dyak, whose superiority over cotton in strength and decay resistance are well known, showed no disadvantages.
2. The standard salmon seine 385 fathoms long belonging to the *California Rose* was rented for use on that vessel. The Fisheries Research Institute furnished 3-inch material for the upper three strips and 2½-inch knotless synthetic for the bunt.

In addition to the above, a spare seine was rented from the vessel *Renown* and stored at Adak in case of loss of one of the three seines.

The knotless bunt material was tried this year in order to reduce injury in the bunt during brailing when the fish are more confined and have a tendency to struggle against the web, especially if the catch is large. The use of fine-meshed knotless material in place of standard heavy knotted web proved far less injurious to the fish. The vessels used canvas brailer buckets, fish holding tanks, and soft nylon dip nets as during last year, which preserved the excellent condition of the fish tagged. Woven nylon in place of knotted web to join the brailer to the canvas bucket improved the brailing apparatus.

In the larger catches this year, it was found that as many as 850 salmon could be held successfully in the tanks. In a few hauls, catches exceeded the tank capacity, in which case the surplus was held in the bunt and dipped directly from there to the tagging boxes. This procedure appeared satisfactory only when seas were calm; otherwise fish held in the bunt were injured by chafing against the web. More than 1,200 pinks had to be released untagged from one haul when weather was too rough to keep them in the bunt.

Table 11 shows the totals caught and tagged by species for each vessel. Table 12 following, gives the numbers tagged by species according to dates and locations. Figure 14 shows the areas referred to in Table 12.

The total number of seine hauls was 296, producing 18,067 salmon for an overall average of 61 salmon per haul. If prospect hauls and hauls made ineffective by tide rips were subtracted, the average would be well over 100 salmon.

As during last year, the net was usually "held open" for 30 minutes, and sets were made "blind". In general, hauls were made in several directions, especially in new areas, to determine the best direction for setting, and to check whether one species might be moving in a different direction than another.

As shown in Figure 14, tagging was distributed along the entire length of the Aleutian chain and well offshore north and south, plus covering the Pribilof Island area. In the offshore fishing, catches were large enough to be practicable, but consistently less than in most inshore areas. Weather was such that the vessels found no opportunity to fish offshore for sustained periods of time. Most fishable weather occurred in periods of from one to three days, in contrast to the week and two-week periods in June, July and August of 1956.

TABLE 11. Totals caught and tagged, 1957 Season.

Catch

	Red	Chum	Pink	Coho	King	Steel-head	Total
California Rose	709	1,678	378	93	109	7	2,974
Commander	1,084	3,711	6,711	28	23	4	11,561
Renown	323	2,039	1,125	9	36	—	3,532
Total	2,116	7,428	8,214	130	168	11	18,067

Tagged

	Red	Chum	Pink	Coho	King	Steel-head	Total
California Rose	637	1,527	364	77	76	7	2,688
Commander	1,007	3,314	4,966	13	11	4	9,315
Renown	305	1,942	1,086	7	26	—	3,366
Total	1,949	6,783	6,416	97	113	11	15,369

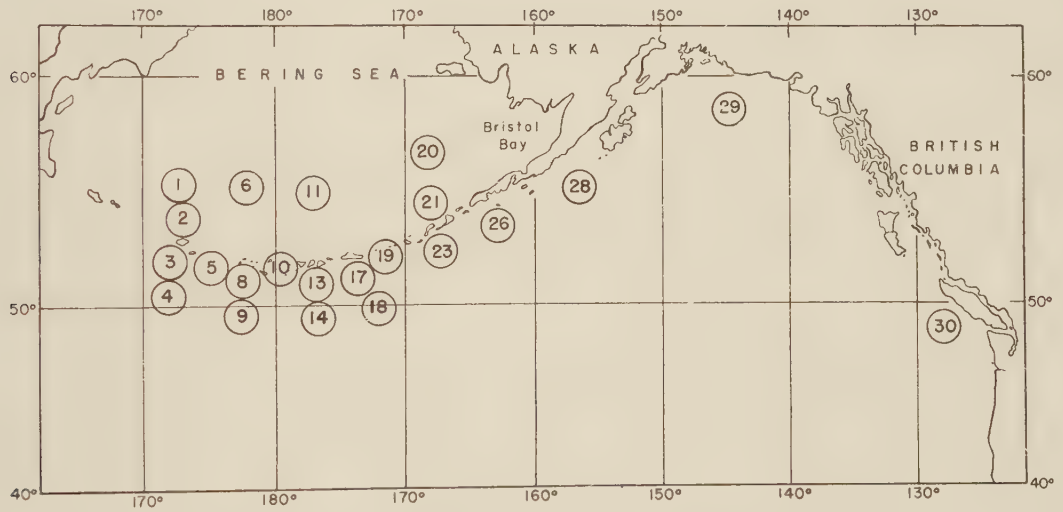

Fig. 14. Tagging location, 1957 (see Table 12).

Because the finer meshed seines held smaller salmon, gilling was much less a problem. As a result, immatures tagged this year should yield better returns than last. Nevertheless, some extremely small salmon gilled, but this difficulty can be practically eliminated in the future by using 2½-inch mesh on the cork line strip and 2-inch mesh in the bunt. It is noteworthy that late in the season several very small red salmon were taken which had migrated to sea only the previous spring. Such salmon are termed zero-sea-check fish, since they are in their first summer at sea and their scales do not yet show a "check" or winter growth mark in the "sea growth" area of the scale.

In comparing results of 1956 and 1957, where fishing was conducted in the same areas both years, several clear-cut contrasts were noted which might well prove significant as continued observations are made.

TABLE 12. Deep Sea Tagging, 1957.

Area No.*	Area Description	Inclusive Dates	Red	Chum	Pink	Silver	King	Steel-head	Total
1	Attu, north side offshore	July 8	—	57	55	—	—	—	112
2	Attu, north side inshore	June 5 - August 23	4	510	74	—	12	—	600
3	Attu, south side inshore	June 8 - August 25	218	1,713	989	—	2	—	2,922
4	Attu, south side offshore	June 9 - July 23	14	22	11	5	1	—	53
5	Buldir Pass	August 5 and 12	66	22	—	—	1	—	89
6	Kiska-Amchitka, n. offshore	July 7 and 16	2	168	7	—	—	—	177
8	Kiska-Amchitka, s. inshore	June 14 - August 23	515	562	947	2	6	1	2,033
9	Kiska-Amchitka, s. offshore	July 20 and 21	2	28	—	—	1	—	31
10	Amchitka Pass	June 27 - August 24	24	495	77	—	—	—	596
11	Adak group, north side offshore	June 28 - July 15	9	297	94	—	—	—	400
13	Adak group, south side inshore	May 25 - August 31	412	1,800	2,817	36	37	—	5,102
14	Adak group, south side offshore	June 21 - July 30	11	76	71	8	2	—	168
17	Atka-Amlia, south side inshore	June 6 - August 16	154	135	655	2	1	4	951
18	Atka-Amlia, south side offshire	July 17 - 19	80	32	1	15	3	3	134
19	Amukta Pass	June 5 and July 6	31	301	153	—	2	—	487
20	Pribilof Islands	June 19 - 26	279	23	6	—	2	—	310
21	Unalaska-Umnak, n. offshore	June 16 - 29	20	2	2	—	3	—	27
23	Unalaska-Umnak, s. inshore	June 13 - July 5	29	427	166	1	3	—	626
26	Unimak Island, south side offshore	May 27 - 29	79	59	194	—	1	—	333
28	South of Kodiak Island	August 23	—	14	—	—	19	—	33
29	Gulf of Alaska	September 7	—	32	—	—	—	—	32
30	Vancouver Island, west coast	September 13 - 14	—	8	97	28	17	3	153
		Totals	1,949	6,783	6,416	97	113	11	15,369

*Arranged west to east (see Figure 14).

1. In the area south of Umnak and Unalaska Islands, the large body of westward-moving mature red salmon which passed by during the entire month of June in 1956 was considerably diminished this year. (Recoveries of these fish in 1956 came entirely from Bristol Bay.) Chum movements in this area were similar to those of last year.

2. Immature red salmon which moved westward in large numbers on the south side of Adak during July and August of 1956 were taken in about 1/5 the numbers this year. (Hauls averaged over 100 in 1956 and less than 20 in 1957.) Chum movements were similar, but noticeably reduced.

3. In all areas fished this year, the age composition of the immature red salmon catches was considerably different from that of 1956. Immature reds are composed of two principal groups; a small-sized group which has spent one winter at sea (one-sea-checks), and a larger-sized group which has spent two winters at sea (two-sea-checks). In 1956, both groups were well represented, but the larger two-sea-check fish were slightly predominant. This year, the smaller one-sea-checks far outnumbered the larger fish. The use of smaller mesh sizes this year no doubt partially accounts for more one-sea-checks, but the difference is more than can be attributed to gear alone.

4. Red salmon were far scarcer this year than last considering both matures and immatures. In spite of the increased effort in 1957, the vessels tagged only 1,949 reds, as compared to 3,402 in 1956. The increased effort produced more chums however. This year, 6,775 chums were tagged as compared to 3,607 in 1956.

5. Pink salmon, of course, formed the greatest contrast with last year. A total of 6,319 were tagged this year, but only 146 in 1956.

TABLE 13. North Pacific Tagging.

Tag Returns — 1957 Experiments (1)
(as of May, 1958)

	Red	Chum	Pink	Coho	King	Steelhead	Total
Total tagged	1,949	6,775	6,319	69	96	8	15,216
Immatures	1,074	5,112	—	—	86	4	6,276
Matures	875	1,663	6,319	69	10	4	8,940
Total runs	53	54	41	—	—	—	148
Percent returns	6.1	3.2	0.6	—	—	—	1.7
(Based on matures tagged)							
Returns in American Coastal Fishery or Streams							
Numbers	37	7	—	—	—	—	44
Percent	4.2	0.4	—	—	—	—	0.5
(Based on matures tagged)							
Returns in High Seas Fishery							
Numbers	16	5	19	—	—	—	40
Percent	1.8	0.3	0.3	—	—	—	0.4
(Based on matures tagged)							
Returns in Asian Coastal Fishery or Streams							
Numbers	—	42	22	—	—	—	64
Percent	—	2.5	0.3	—	—	—	0.7

(1) Excluding those tagged off Vancouver Island (see below)

Returns from Vancouver Island Tagging

	Red	Chum	Pink	Coho	King	Steelhead	Total
Number tagged	—	8	97	28	17	3	153
Number recovered	—	—	18	3	1	—	22
Percent recovered	—	—	18.6	10.7	5.9	—	14.4

Both tube and disc tags were used again this year. The principal tag was the very soft, white tube material, but the yellow was also tried to compare success of recovery. Similarly some of the stiffer Hyflex material was tried, but proved very slow to use, being difficult to tie at low temperatures. The numbers of the various types of tags applied during 1957 were as follows:

White tube tags of 1/16″ soft vinyl (Ivi-Flex)	10,985
Yellow tube tags of 1/16″ soft vinyl (Ivi-Flex)	1,334
White tube tags of 1/16″ soft vinyl (Hyflex)	369
White disc tags of ½-inch diameter	2,681
Total	15,369

Tables 13 and 14 show recoveries for 1957 and 1956 tagging respectively. For 1957, recovery percentages are based on numbers of *matures* tagged as given at the top of the table. For 1956, the percentages of *1956* recoveries are based on numbers of *matures* tagged, and the percentages of *1957* recoveries on numbers of *immatures* tagged.

TABLE 14. North Pacific Tagging

Tag Returns — 1956 Experiments (1)

(as of May, 1958)

	Red	Chum	Pink	Coho	King	Steel-head	Total
Total tagged	3,402	3,607	146	6	38	2	7,201
Immatures	1,572	2,280	—	—	33	2	3,887
Matures	1,830	1,327	146	6	5	—	3,314
Returns 1956	100	53	1	—	—	—	154
Percent 1956 (2)	5.5	4.0	0.7	—	—	—	4.6
Returns 1957	29	41	—	—	1	—	71
Percent 1957 (3)	1.8	1.8	—	—	3.0	—	1.8
Returns in American Coastal Fisheries or Streams							
Numbers 1956	99	31	—	—	—	—	130
Percent 1956 (2)	5.4	2.3	—	—	—	—	3.9
Numbers 1957	13	4	—	—	1	—	18
Percent 1957 (3)	0.8	0.2	—	—	3.0	—	0.5
Returns from High Seas Fishery							
Numbers 1956	1	1	1	—	—	—	3
Percent 1956 (2)	0.05	0.08	0.7	—	—	—	0.09
Numbers 1957	16	21	—	—	—	—	37
Percent 1957 (3)	1.0	0.9	—	—	—	—	1.0
Returns in Asian Coastal Fisheries or Streams							
Numbers 1956	—	21	—	—	—	—	21
Percent 1956 (2)	—	1.6	—	—	—	—	0.6
Numbers 1957	—	16	—	—	—	—	16
Percent 1957 (3)	—	0.7	—	—	—	—	0.4

(1) Excluding those tagged off Southeastern Alaska and B. C. (see below)
(2) Based on matures tagged
(3) Based on immatures tagged

Returns from Southeastern Alaska and B. C. Tagging

	Red	Chum	Pink	Coho	King	Steel-head	Total
Numbers tagged	1	30	93	41	2	3	170
Numbers recovered	—	4	—	4	—	—	8
Percent recovered	—	13.3	—	9.8	—	—	4.7

An item of major interest was the recovery in 1957 of immatures tagged in 1956. The success of return which might be expected from reds and chums due to spend another year or more at sea was unknown. The upper part of Table 14 shows the percentage to date to be 1.8 for reds, and 1.8 for chums. These percentages, though low, provide returns in numbers sufficient to furnish a fair picture of the distribution after a year at sea. (See Figures 17 and 18.) These are the first tagging experiments in which appreciable numbers of reds and chums have been recovered a season following their tagging.

The lone king salmon was especially interesting, as it travelled from Adak to the Salmon River in Idaho, or a minimum of 3,500 miles between August 11, 1956, and July 7, 1957. In the meantime, it grew from 19 inches to approximately 24 inches. A single chum salmon made the trip from Adak to Southeastern Alaska.

All of the 1957 recoveries of reds and chums tagged in 1956 came from among the two-sea-check group, or those which had already spent two winters at sea at the time of tagging. Normally a fair percentage of the 1956 one-sea-checks would also be expected to mature and return to spawn in 1957, but none of this group were recovered. Perhaps some of these one-sea-checks will be recovered next year, or perhaps the natural mortality rate of this group has greatly reduced the chance of recovery. Also, their condition at tagging was poorer, because of gilling in the larger web used in 1956. As mentioned earlier, more one-sea-checks were tagged this year, and their condition was much better.

Figures 15 to 21 illustrate the recovery patterns for the tagging in both 1956 and 1957. In each figure, arrows drawn conveniently from the tagging location to the recovery location, take into account the direction of movement of the majority of the fish at the time of tagging. Other than the latter, no suggestion is intended of the actual migratory path, especially of those recovered a year after tagging.

Figures 15 and 16 are a repetition of the figures given in the 1956 report, included to facilitate comparison of 1956 and 1957 recovery distributions.

Figure 17 indicates the recovery picture for reds recovered a full year after their tagging in 1956, all having been tagged in the area just south of the Adak group. The chart is rather small for indicating numbers, but Table 14 shows that of the 29 recovered, 13 were taken in Bristol Bay estuaries while 16 were intercepted by the Japanese high seas fishery. None was returned from Asian estuaries or streams.

Similarly Figure 18 presents the distribution of chums after a year at sea. Recoveries came from widespread areas, originating from three tagging locations. Each arrow indicates a single recovery. Four were taken in Alaskan estuaries, 21 in the Japanese high seas fishery and 16 from Asian estuaries (Table 14).

Figure 19 shows the distribution of red salmon recoveries from the 1957 tagging. The pattern is very similar to that of the mature reds tagged and recovered in 1956 (Figure 15). Reds moving westward along the south side of the Aleutians ultimately were recovered in Bristol Bay and Alaska Peninsula estuaries. In 1957 the tagging was extended westward to Attu, and northward of Adak, but again recoveries came from Bristol Bay estuaries, as did all recoveries from tagging near the Pribilof Islands. The principal difference in the 1957 results is the increase in the number of reds intercepted by the Japanese high seas fishery (one in 1956 against 17 in 1957: see Tables 13 and 14).

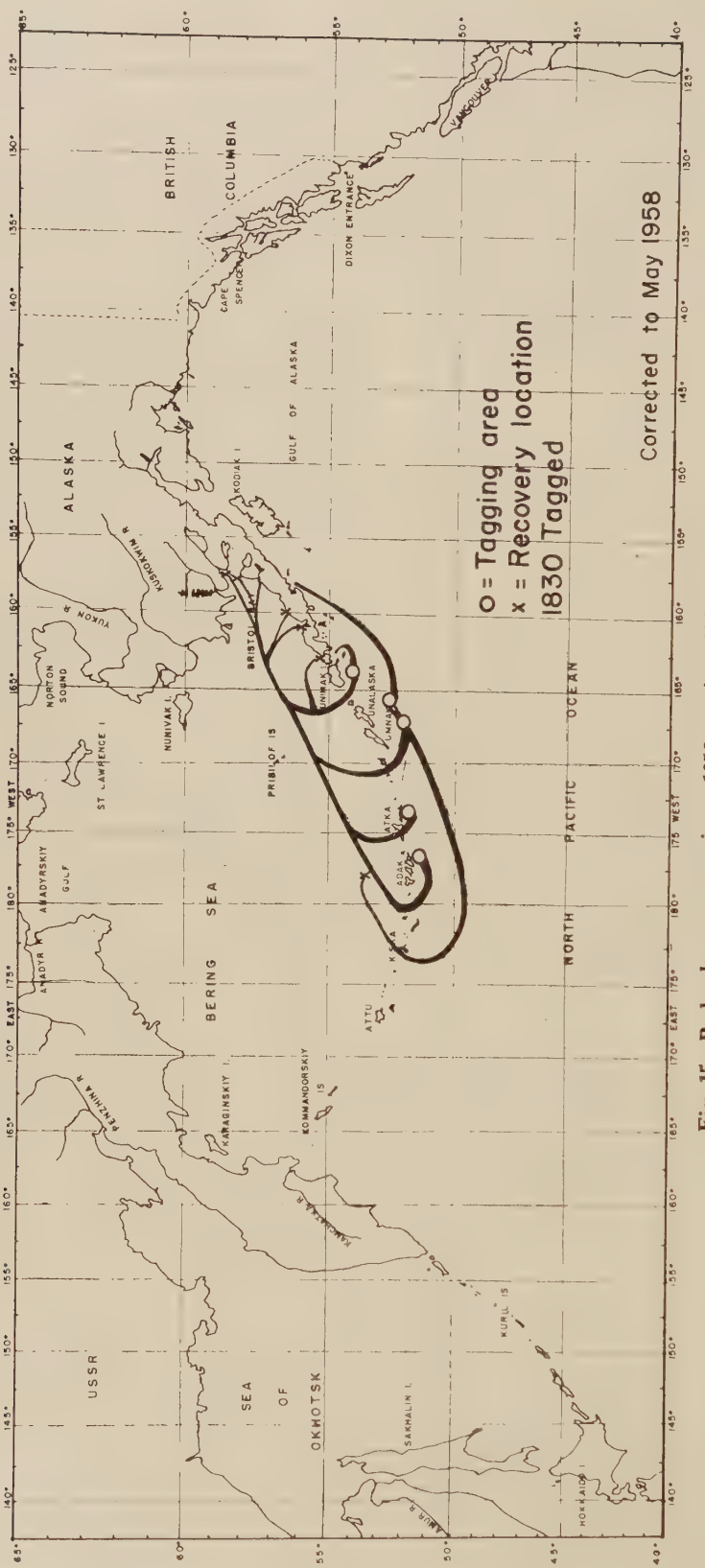

Fig. 15. Red salmon recoveries — 1956 tagging, 1956 recoveries.

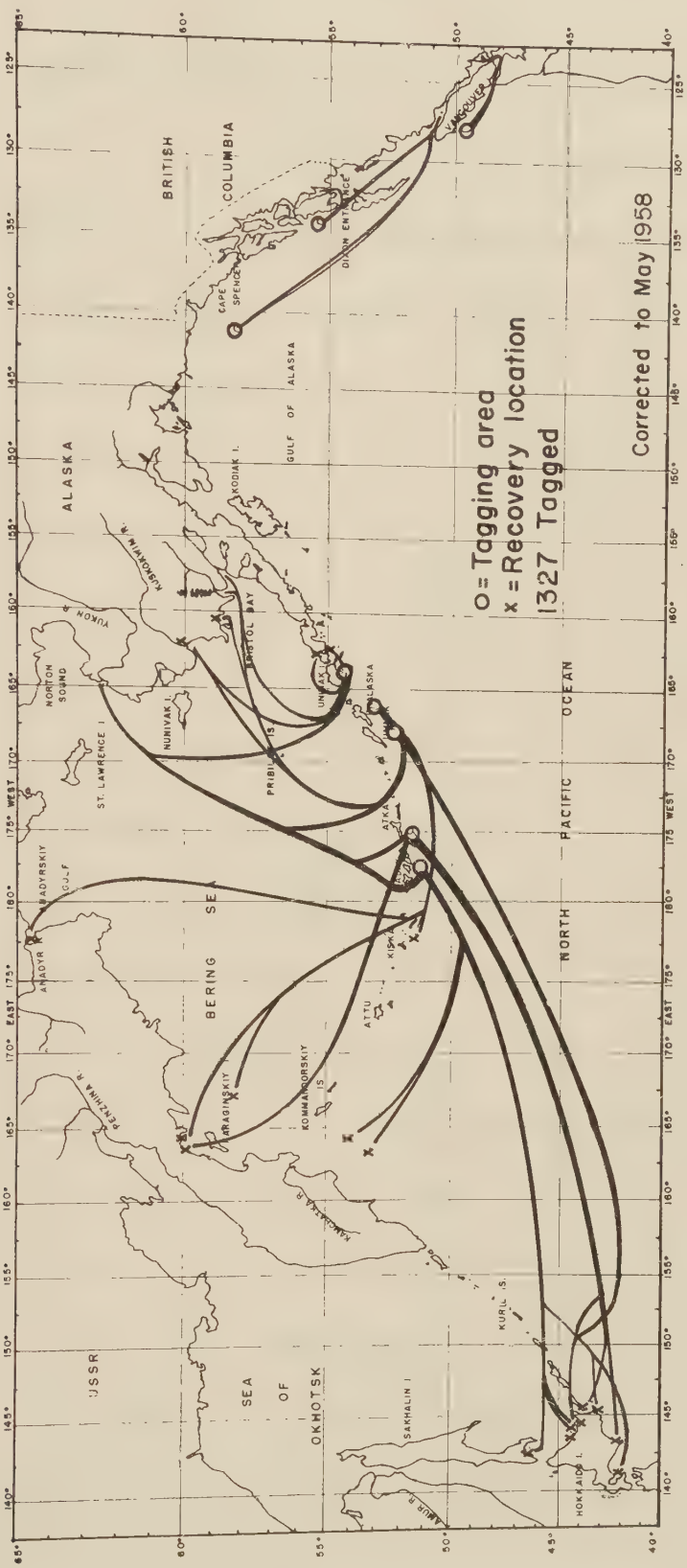

Fig. 16. Chum salmon recoveries — 1956 tagging, 1956 recoveries.

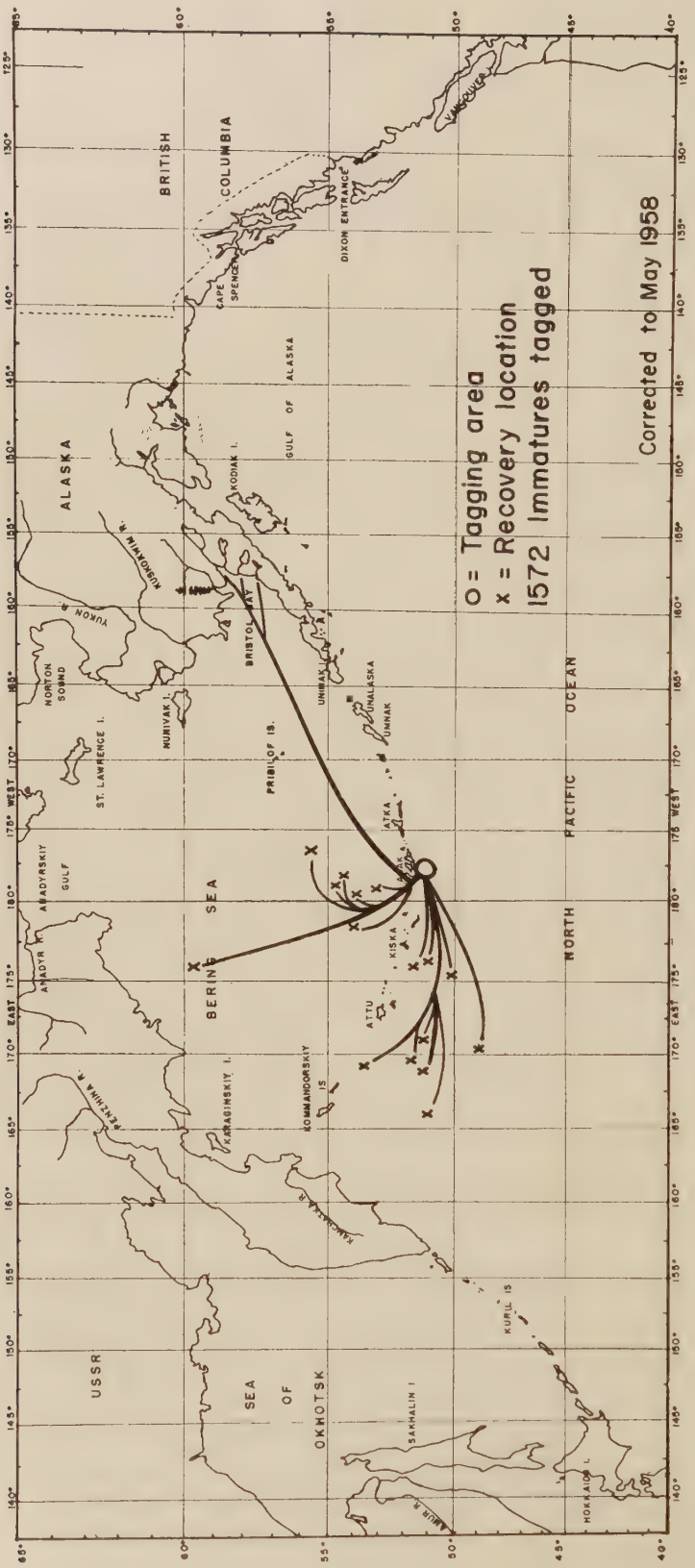

Fig. 17. Red salmon recoveries — 1956 tagging, showing those recovered a year after tagging (1957).

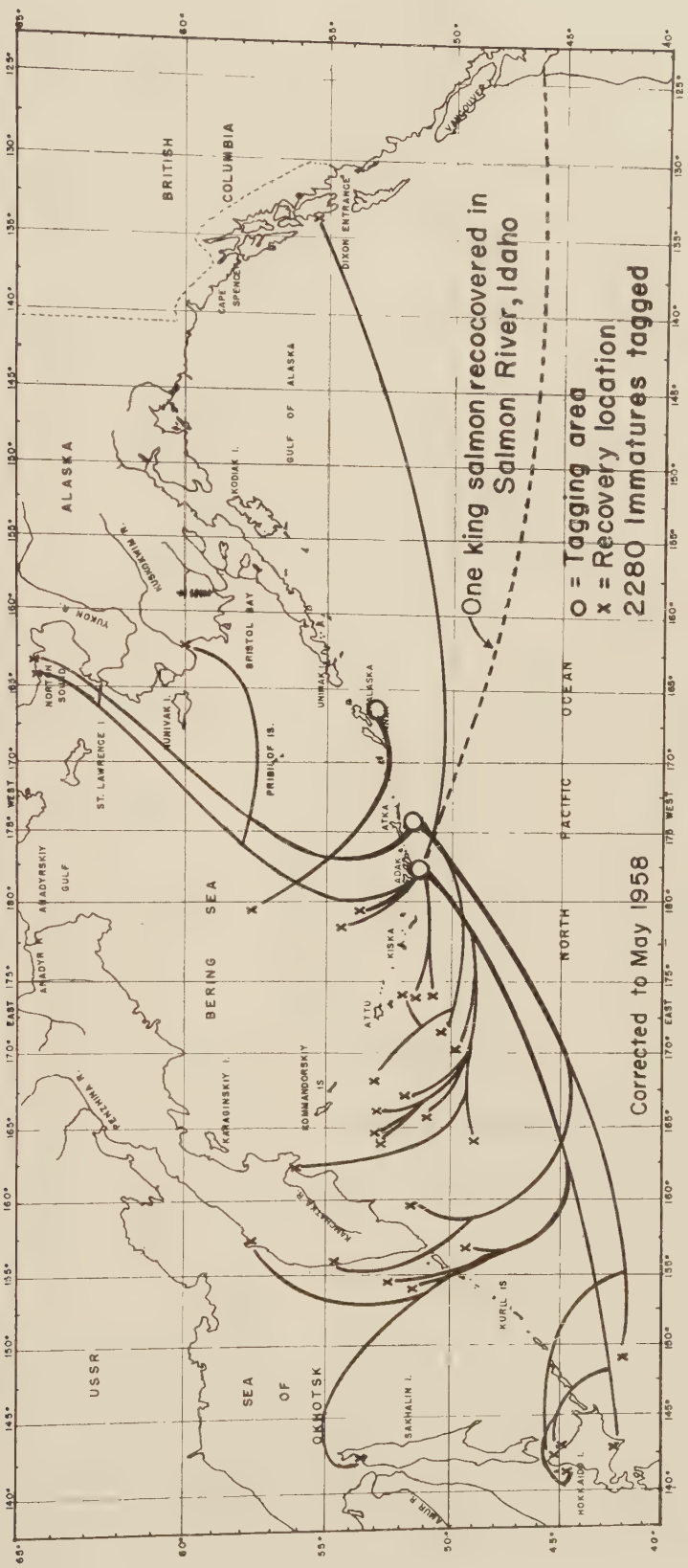

Fig. 18. Chum salmon recoveries — 1956 tagging, showing those recovered a year after tagging (1957).

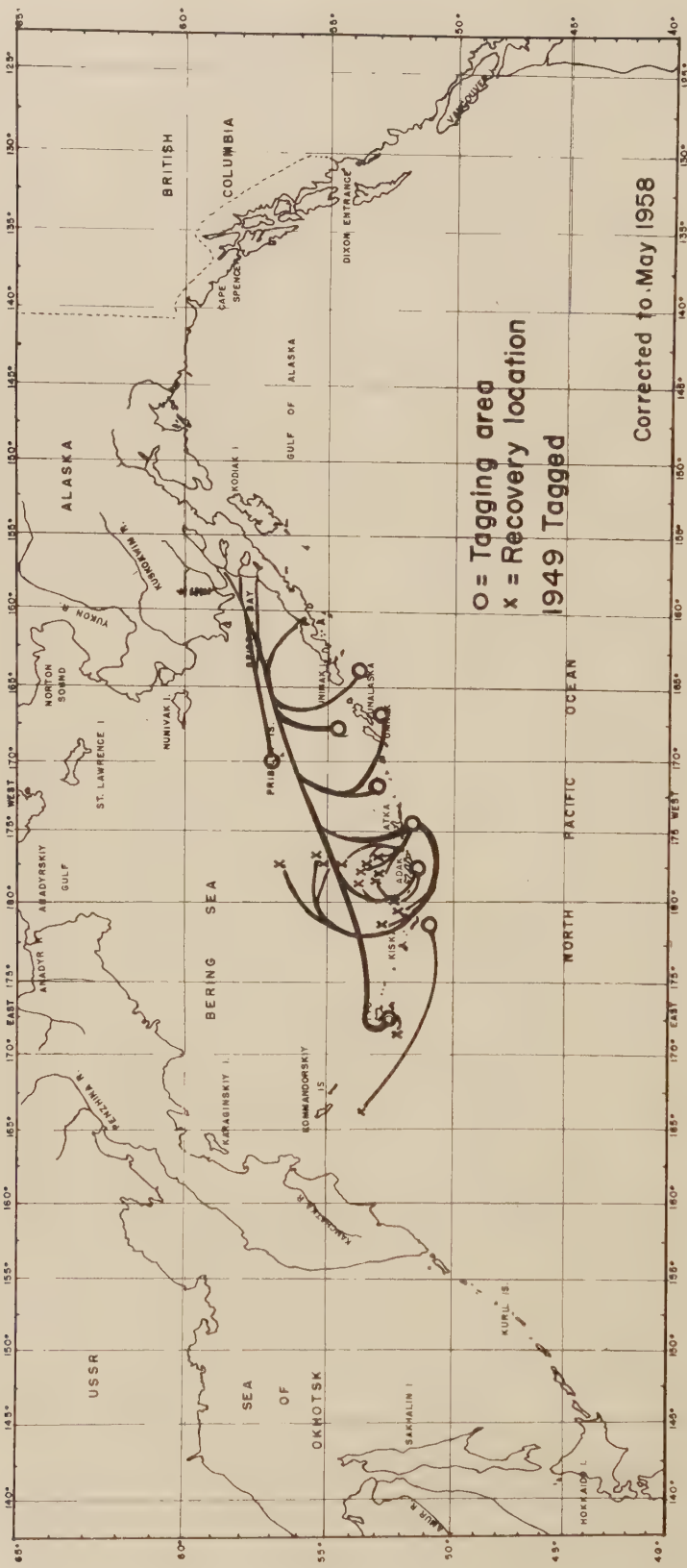

Fig. 19. Red salmon recoveries — 1957 tagging.

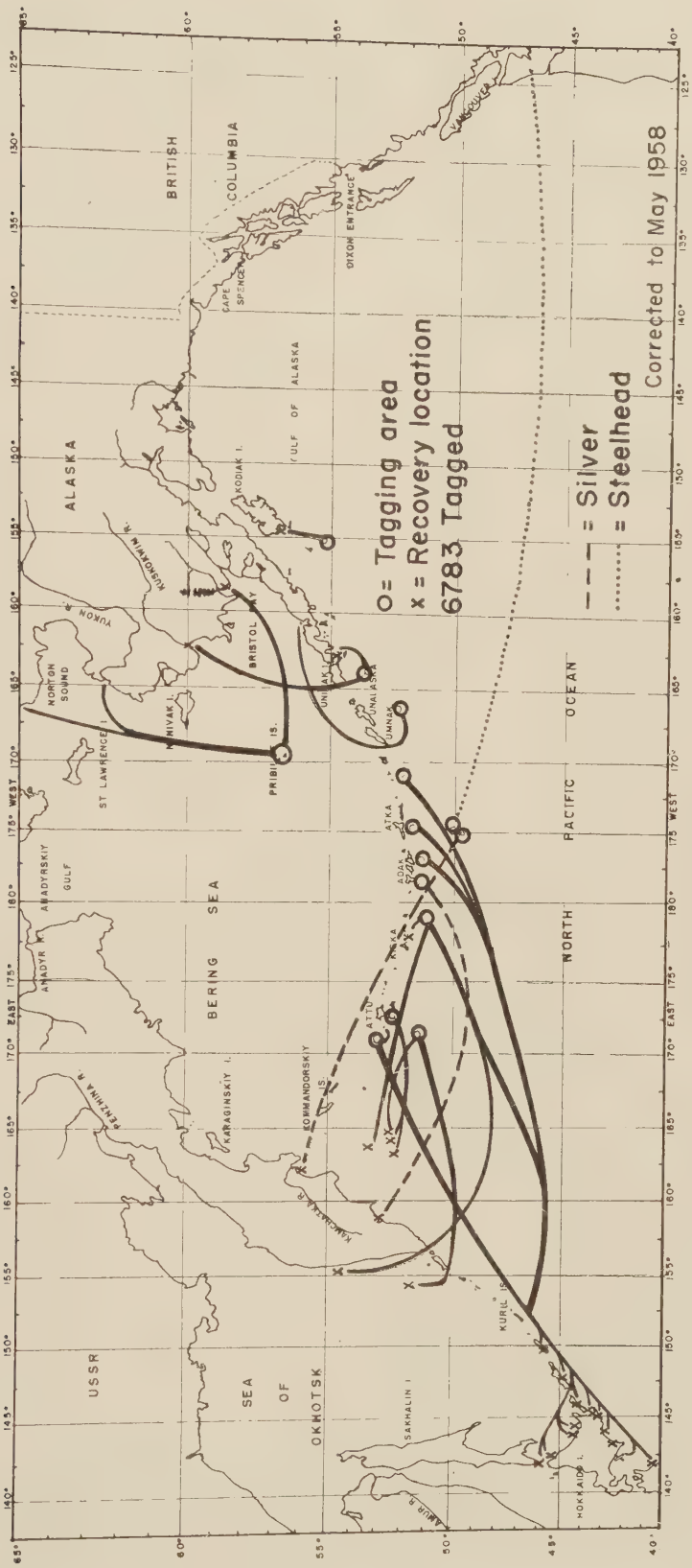

Fig. 20. Chum salmon recoveries — 1957 tagging.

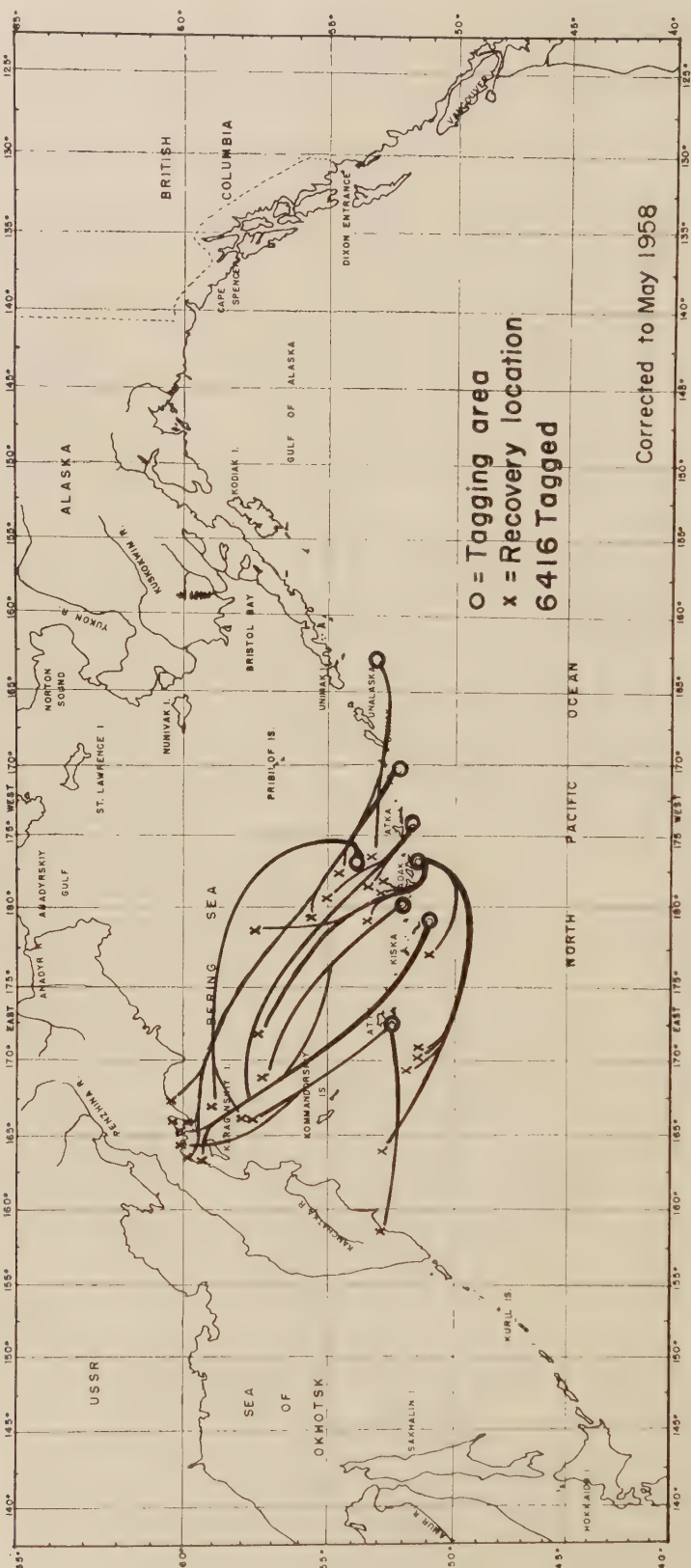

Fig. 21. Pink salmon recoveries — 1957 tagging.

The pink salmon, as shown in Figure 21, were recovered west of the point of tagging in every case. The percentage recovery (0.6%, Table 13) was extremely low, and difficult to explain since there is no question that all were mature. It should be emphasized that 1957 was a poor year for pinks in American areas and apparently a good year in Asian areas. In years when American streams are productive, the tagging may well show a different picture. During 1956, for instance, pinks were scarce in the high seas areas found productive in 1957. Apparently no appreciable numbers of either Asian or American pinks were present that year.

Six kings from the 1955 tagging were recovered in 1957. Thus, of the 270 kings tagged in the Swiftsure area in May and June of 1955, the following recoveries were subsequently made.

Year	*Number of Fish*	*Percentage*
1955	28	10.4
1956	13	5.4
1957	6	2.6

These data speak well of the probability that tags will remain on salmon at sea. The recovery percentages for 1956 and 1957 are corrected only for the numbers previously recovered, and therefore are minimums, since an unknown number also would be expected to leave the fishery each year for spawning.

KING CRAB INVESTIGATIONS

During 1957 the king crab investigators have emphasized the field phases of the study, the major part aboard the *Mitkof*, which operated in the Bering Sea from mid-May to mid-September. The observers have followed the operational plan which was presented in April, 1957.

Trend of Fishery

The king crab fishery in the Bering Sea encountered an abundance of crabs in the past year. Preliminary reports indicate that the fishermen found crabs in greater numbers than were encountered in the preceding few years for which we have records. Following the relatively poor fishing of 1956, the increased success of fishing in 1957 is particularly noteworthy. We are certain that the improvement in fishing is real, but it is not known whether more crabs are present or whether they are simply more available to the fishery.

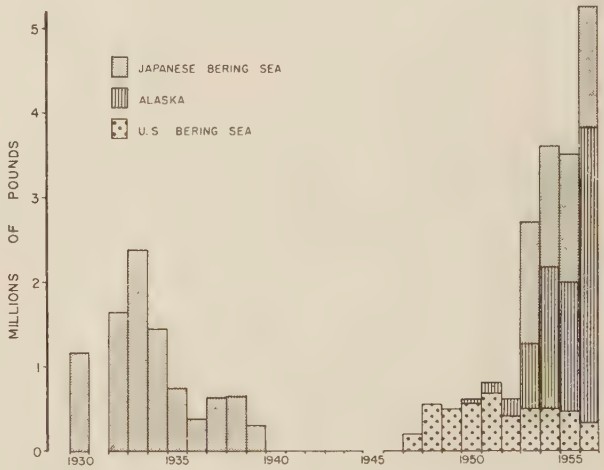

Fig. 22. King crab production in Alaska and the eastern Bering Sea.

The catch of king crabs from the Bering Sea has remained practically constant for the past several years; however, this is to be expected since the bulk of the catch is taken by the Japanese mothership fishery which has operated under a fixed catch quota of approximately 59,850 cases of canned crab. The mothership operates only long enough to make this catch. The 1957 season was particularly short since fishing was excellent. Figure 22 shows the Bering Sea and total Alaska king crab production, in pounds of finished product. The statistics reflect the recent and continuing growth of the crab fishery as a whole.

Growth

The extent of the fishery which the Bering Sea king crabs can support is determined to a large degree by their rate of growth. Observations of tagged crabs provide evidence for determining the rate, although the nature of the crab's growth by moulting makes accurate results difficult at this early stage of observation. Therefore Figure 23 shows two growth rates: the maximum which would result if the crabs moulted annually, and the average, which is the result of combining the growth from tagged crabs with the observed percentages moulting for each size. This figure was constructed by adding to the smallest size for which growth had been observed (110 mm.), the calculated growth for each successive moult at the rate of once annually. In the case of average individual growth, the annual amount was decreased by the observed percentage of non-moulting crabs of that size. The "maximum growth rate" assumes an annual moult.

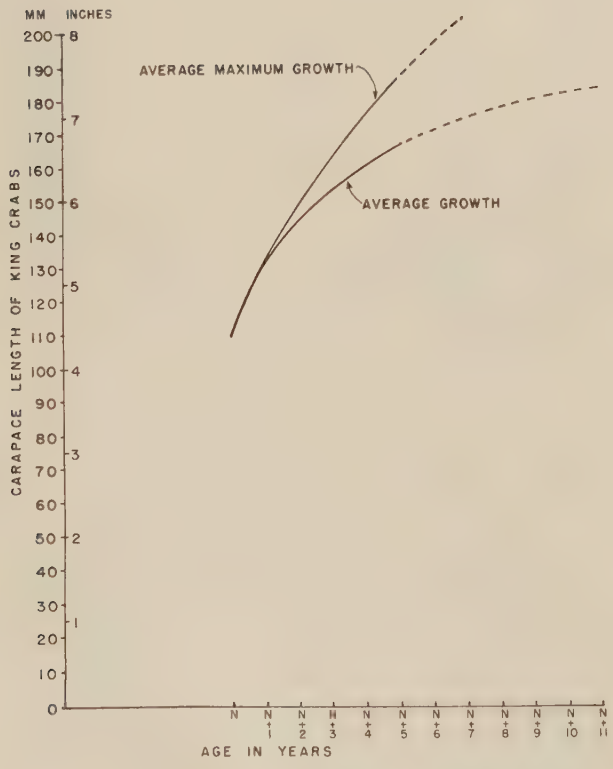

Fig. 23. Growth of Bering Sea king crabs from tags.

Figure 23 should not be regarded as a completely accurate depiction of growth rate; it is presented at this time as a demonstration of a method being used and our progress with it. We have as yet too few recoveries showing growth to allow us to establish firmly the amount of increase at shedding, especially for the smaller and larger sizes. We also suspect that the frequency of moulting and therefore growth may not be the same every year. Data are needed also for sizes smaller than 100 millimeters if the total age is to be established. We have begun to accumulate information for the small crabs.

Abundance

During July the *Mitkof* occupied a series of 77 fishing stations (Figure 24) to attempt to estimate the number of king crabs of commercial size in the eastern Bering Sea. The pattern covered the ground inhabited by these crabs quite well with the possible exception of the area off Unimak Pass which is too rough to trawl. At each station the observers recorded the number, sex, and size of crabs caught. From calculations to determine the density of crabs per unit area, it was estimated that the number of crabs more than 135 mm. in carapace length (6½ inches in width) was 19,186,824. Of this number, about 17.7 million were more than 6½ inches wide, and 12.25 million were more than 7. Although other factors will be considered in a final count, it is not likely, however, that the general magnitude of the estimate will be changed, as the estimate is probably of a minimal nature, since it is based upon the assumption that the trawl caught all of the crabs in its path. Further, by the time the survey was made, a 1957 catch in excess of 1,000,000 large crabs had already been taken.

These estimates agree generally with the rate of tag recovery from the fishery. Approximately 5% of the tags released in 1956 have been recovered by the 1957 fishery.

Tagging

Table 15 gives the numbers of tags released and recovered in 1957. The release of tags for the current year has been completed.

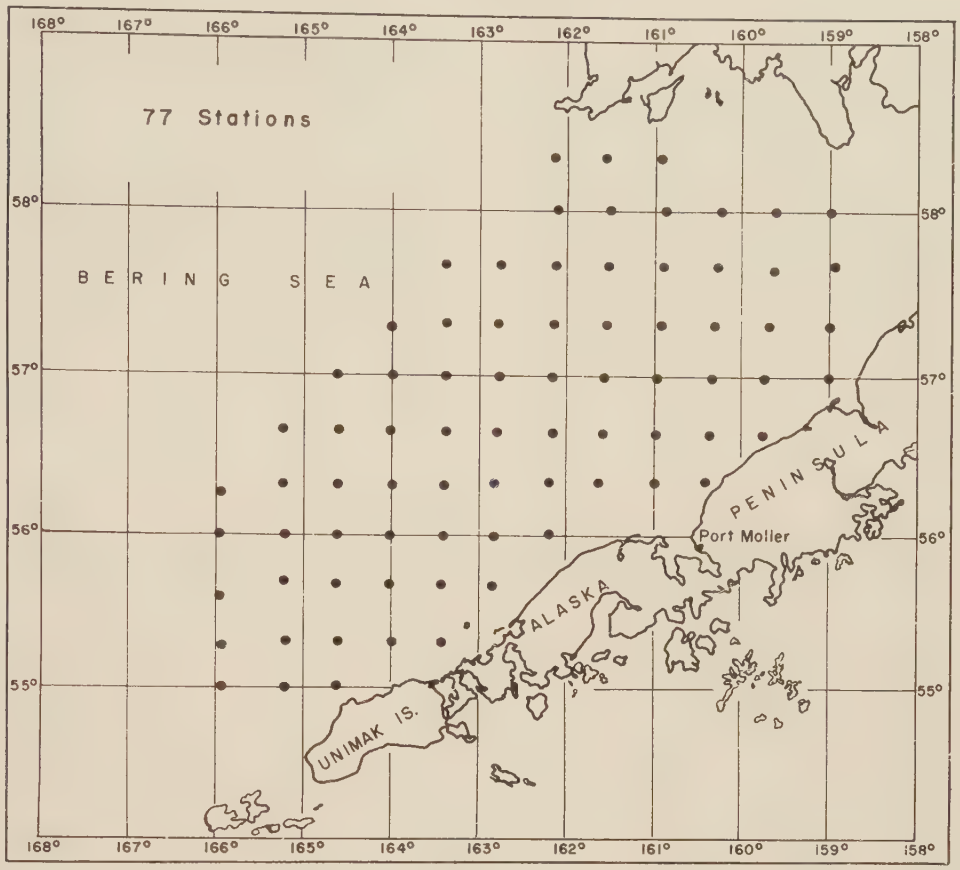

Fig. 24. King crab station pattern, July 1957.

TABLE 15. Summary of Tag Recoveries, 1957

Tagging Year	Numbers Released	Year Recovered — Numbers Recovered (Percent Recovered)				
		1954	1955	1956	1957	Total
1954	1,107	44 (4.0%)	60 (5.4%)	1 (0.1%)	2 (0.2%)	107
1955	1,351		32 (2.4%)	53 (3.9%)	35 (2.7%)	120
1956	4,063			53 (1.3%)	197 (4.8%)	250
1957	13,747				42 (0.3%)	42
	TOTAL:	44	92	107	276	518

Current Studies

The almost total absence of information relating to the circulation of water in the eastern Bering Sea has been a handicap in determining the origin(s) of the stocks of king crabs, because at early planktonic stages, they drift with the water. During June, 1957, the field observers noted the direction the water was moving at four of the stations shown in Figure 24, and measured the flow by using a current meter at hourly intervals throughout a complete tidal cycle. After the effect of flooding and ebbing tides has been removed, the net transport of water is as shown in Figure 25. Some differences exist between the movement of surface and bottom water, but the net movement seems to be of a counter-clockwise nature in the Bristol Bay area. The movement of water is particularly important with regard to the distribution of newly hatched free swimming crab larvae. Due to the low velocity of this water, the distribution of crab larvae hatched in the Port Moller area should not be extensive.

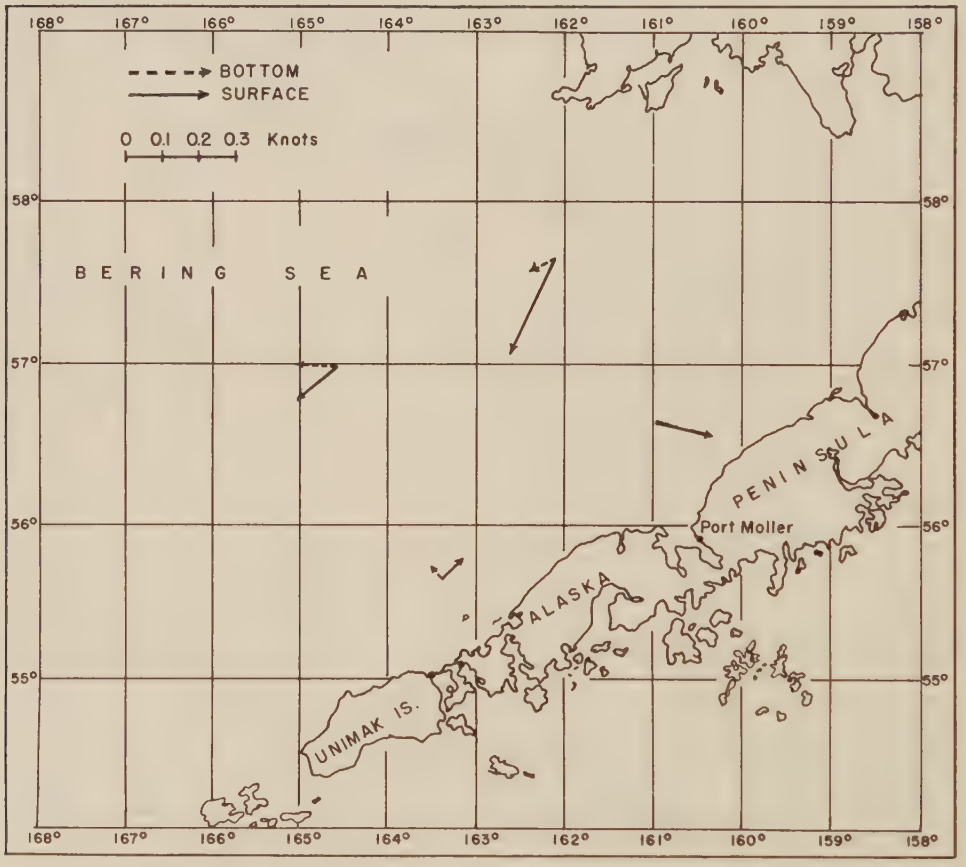

Fig. 25. Net current direction and velocity at surface and bottom.

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